Clarivate

Analytical report by Clarivate

Analysis of UK institutional research diversity

Universities UK



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Executive Summary

Introduction

This report is about the distribution of research activity across higher education institutions in the UK. The analysis is primarily focussed on the growth, volume, impact and diversity of research at subject level. It considers factors such as collaboration and regional distribution, and it considers diversity and similarity at institutional and regional levels.

The report provides background data on the development and current state of research subject diversity as material for an informed policy discussion. In late 2025, UK Research & Innovation, the body overseeing and responsible for disbursement of the UK budgets for research through the Research Councils and Research England, indicated that it was reviewing policy around the distribution and concentration of research funds with a possible view to taking account of the nature and degree of institutional research specialisation and diversity.

The subject affiliation of the researchers themselves cannot be identified directly from their published research. Institutional subject diversity is instead indexed in this analysis using research publication output at the level of 254 Web of Science journal subject categories. Each institution is indexed by comparison with overall UK national research subject diversity. This standardises the assessment of research diversity across institutions and enables international comparisons. It is worth noting that the diversity of an institution´s publication output reflects the partnerships through which its researchers work as well as its own staffing, since collaboration gives access to a wider range of expertise than each contributing institution provides alone.

Regional research diversity

Research portfolios at the level of the major UK regions are remarkably similar. All regions maintain activity across a broad range of disciplines, and none exhibit a narrowly concentrated profile (Table 1, Figures 1and 2). This is likely to be a natural consequence of any large region containing many institutions, leading to an organic diversity. However, some structural differences emerge at finer geographic resolution (Figure 3). While some regions combine relatively specialised institutions within a diverse regional research portfolio, others achieve similar levels of diversity through the scale and breadth of a small number of major universities (Figure 4).

Diversity and research excellence

Research excellence broadly follows the pattern observed for overall research activity. Although highly cited research is somewhat more concentrated than institutional publication portfolios as a whole, the difference has diminished over time (Figure 5). Institutions that have become more diverse in their overall research activity have generally also become more diverse in the distribution of their highest-impact research (Figure 6). Excellence therefore appears increasingly distributed across a broader range of disciplines within institutions rather than being confined to a few subject areas.

In line with prior studies, there is little support for the assumption that research excellence is inherently associated with narrow institutional specialisation. Broad and multidisciplinary institutions are able to sustain excellent research across a wide range of subjects, while more specialised institutions make important contributions in focused areas (Figure 8). Specialisation, diversity and excellence therefore appear compatible characteristics of the UK research system rather than competing objectives.

International research collaboration and diversity

There has been a large rise in international research collaboration over recent decades. For UK universities, this rise accounts for the greater part of their growth in published output, and citation impact has also risen for most institutions (Appendix 3). Institutional collaboration has generally been greatest in their well-established subject categories, but innovative exceptions are also seen, especially in AI and in environmental research. It is likely that collaboration-driven growth contributes to some of the rise in diversity in smaller institutions.

For larger research-intensive institutions, collaboration is most common with UK and international peers, particularly with older institutions in G7, EU and anglophone countries. Pre-92 institutions generally have a good national network across core areas and a broad spectrum of international links. Regional collaboration is more strongly evident among newer and smaller institutions, but their international links are growing, and some of their partners are in newer research economies. (Appendix 3)

Diversity and similarity

The diversity and distinctiveness of an institution's research are not tightly linked. Many UK universities have broad research activity and, unsurprisingly, a similarity analysis indicates that substantial overlap exists between these broader portfolios, particularly among the older research-intensive universities (Figure 9). Increasing generalism within smaller and newer institutions has also seen them converging towards the UK background (Figures 10 and 11).

Diversity and differentiation, although related, are separate dimensions of the research system. Some diverse regions contain institutions with relatively similar research portfolios, while others derive diversity from a mixture of more distinctive institutional strengths. The strongest evidence of differentiation is often associated with institutions that maintain more specialised missions. The results suggest that the UK research system derives its long-term resilience and capability from a combination of broad-based institutions, synergistic strengths and specialised centres of expertise.

1. Introduction

Research assessment and selective resource distribution are usually associated with the support of research excellence, but that is not necessarily the only objective. An assessment system may also be directed towards the support of the best research training environments, towards research of national importance, or towards research of economic significance such as sustaining regional innovation and growth.

Policy discussions on research diversity tend to assume that the focus is research subject/field diversity. However, diversity by region, by organisational type, by research mode and mission, and by funding support mechanisms are equally important socio-economically. Furthermore, there is no objective way of defining the research portfolio of an institution as either specialist or not, because it is a relative characteristic and any useful analysis needs a benchmark and an indicator.

Research resources are selectively distributed both through block grants geared against institution size and research performance and through peer-reviewed grant awards from open and directed programmes. Nearly half of the core research funding for English universities goes to 10 of over 130 institutions. A high proportion (about 45%) of the block grants allocated for research in England go to just two of the nine English regions (London and the South-East). However, data suggest that relatively less well funded regions deliver outcomes that are nonetheless of equal impact to those better funded.

Almost constant attention has historically been given to the selective distribution of research resources and there have been many policy initiatives around the balance of specialisation, concentration and diversity. Some of these have been primarily conceptual and analytical while others have led to action, sometimes at significant cost. It is informative to be aware of these episodes.

1.1. Origins, impact, and direction

In 1850, the UK Treasury first allocated funds to the Royal Society to award grants to individual scientists and, in 1889, established an ad hoc Committee on grants to distribute £15k it had set aside for 11 university colleges (about £1.7 million in current prices). Research was also supported by a Medical Research Committee and Advisory Council, founded in 1913 to distribute medical research funds under the terms of the UK's National Insurance Act 1911. The Department for Scientific and Industrial Research (DSIR) was established at the end of 1916, to support civil science and to co-ordinate and commission its own research [1]. A University Grants Committee (UGC) was established in 1918 to manage the Treasury grants that now paid for salaries and preliminary investigations, while the DSIR gave university scientists funds to carry out specific research. There were only 24 DSIR funded university postgraduate research studentships in 1917, and this number had grown to no more than 81 by 1938.

Selectivity became more apparent in the UK after 1945. The UGC grant was moved to the Board of Education which required the UGC to take a more active stance on university policy, and it operated some level of selective funding from then onwards. The numbers of trained research professionals in universities doubled during the 1950s, by 1962 science research spend was at least tenfold that in 1945 [2] and the spend on conventional science had at least doubled in real terms.

1.2. A continuous narrative around selectivity and concentration

Throughout the growth period during the 1964 Wilson Government, which had asserted the significance of technology for economic revival, there was clear evidence of overt and very marked selectivity. Success in attracting research grants was

[1] Varcoe, I. (1974). Organizing for science in Britain. Oxford University Press, Oxford.
[2] Wilkie, T. (1991). British science and politics since 1945. Blackwell, Oxford.

evidently significant in the UGC's assessment of research excellence [3]. Correspondence in the Journal of the Royal Statistical Society discusses special factors for research: a concentration effect - 'an increasing payment per student in respect of non-teaching functions as universities get larger'; and speculation about 'an unusually high level of support for certain privileged areas' [4].

The UGC Annual Survey 1976-77 introduced planning figures based on four-year projections[5]. Budget constraints meant that the well-found department could no longer be guaranteed, but the UGC would, after discussion with the Research Councils, make a selective allocation of some £500k to enable some 11 institutions specific participation in identified areas of high priority.

The Merrison Report from 1982[6] coincided with severe cuts in public funding, largely associated with the global oil crisis of the 1970s. The Report concluded that "we are convinced that whatever research is done should be of high quality and properly supported, and this means that universities will need to concentrate research funds into selected areas". Universities should set up internal Research Committees to make selective allocation not on a project basis, but to create a strong infrastructure, and this might mean that some university departments would not be able to sustain a viable research base.

The Morris Report from 1983[7] also expressed support for selectivity among research committees. "Each university, through its research committee, will have to choose which of its staff to support and which not to … some departments may well develop into departments dominated by their teaching activity". The Joint Report of the Chairmen of the ABRC and ACARD proposed that there should be national and overt policy of selectivity among research objectives.

'A Strategy for Higher Education into the 1990s' [8] suggested (at par. 5.14) a "more selective allocation of research support among universities" in order to ensure that resources for research were used to the best advantage. The UGC confirmed that it had in the past "taken account of research achievement but not previously implemented the principle of interaction or responsiveness" identified in its recommendation. Subsequent paragraphs developed the rationale for a selective approach that would be related to but not passively dependent on the existing dual support system.

1.3. Direct intervention with institutional structures

In 1987, the ABRC's 'Strategy for the Science Base'[9] recognised that "the changes that are taking place in the approach to organisation and management of research … the development of selectivity and more directive management … can be seen as the inevitable response to the challenge of managing science within finite resources". It expressed support (par. 1.21) for the Oxburgh review on the Earth Sciences, the report of which concluded that resources for that subject were over-dispersed.[10]

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[3] UGC (1984). A strategy for higher education into the 1990s; the University Grants Committee's advice. HMSO.

[4] Cook, W. R. (1976). How the University Grants Committee determines allocations of recurrent grants - a curious correlation. Journal of the Royal Statistical Society (A), 139, p. 374-384; Cook, W. R. (1977). Curious correlations - a reply. Journal of the Royal Statistical Society (A), 140, p. 511-513; Dainton, F. (1977). Comments on "How the UGC determines allocations of recurrent grants - a curious correlation". Journal of the Royal Statistical Society (A), 140, p. 199.

[5] UGC (1966). University Grants Committee, Annual Survey for the academic year 1965-1966. Cmnd 3192, HMSO; UGC (1967). University Grants Committee, Annual Survey for the academic year 1966-1967. Cmnd 3120, HMSO; UGC (1980). University Grants Committee, Annual Survey for the academic year 1979-1980. HMSO.

[6] ABRC/UGC (1982). Report of a joint working party on the support of university scientific research. Cmnd 8567, HMSO. (The Merrison Report).

[7] ABRC (1983). The support given by Research Councils for in-house and university research. The Morris Report.

[8] UGC (1984). A strategy for higher education into the 1990s; the University Grants Committee's advice. HMSO.

[9] ABRC (1987). A strategy for the science base; a discussion document prepared for the Secretary of State for Education and Science by the Advisory Board for the Research Councils. HMSO.

[10] UGC (1987). Strengthening university Earth Sciences; report of the Earth Sciences review. UGC, London.

Reviews were also carried out for Chemistry and for Physics but only the Earth Sciences review led to action. At significant capital and human cost, entire departments were relocated from smaller to larger campuses: for example, the department at Durham was closed and the staff and researchers were transferred to Leeds. The costs were found to be so great, and the disruption for individual researchers so detrimental, that additional Chemistry and Physics amalgamations were ruled out.

Nonetheless, selectivity and concentration were pursued. The ABRC suggested (par. 1.25) that the allocation of Research Council grants to scientists in below average departments was "not conducive to the concentration of effort that we believe generally to be in the national interest". Its considerations led the ABRC to conclude that polices then in place would not lead quickly enough to the degree of concentration required to maintain the international competitiveness of university research (then, among 60 institutions). The proposal that emerged was for an R-T-X system of institutions differentiated according to the pervasiveness and breadth of their research strength, with just 15 institutions in the top R category of substantial international research across most fields.

This represented a key shift in the overt rationale for selectivity, because it introduced the idea of selectivity among institutions with the express purpose of concentrating funding to create centres of excellence. This rationale depended on the underlying, and unproven, concept that excellent Physics research was more likely to emerge if it were done alongside excellent Chemistry research, and so on.

The UFC´s first annual report (in 1987) had focussed on arrangements made by universities to bring about selective distribution of resources, and the second report in the following year looked at selectivity processes and the way in which these supported groups or departments rated above-average by its 1986 selectivity exercise. The UFC's third report subsequently reflected growing discomfort with mechanical selectivity that depended on 'yesterday's successes', and which might stifle creativity. It did note (par. 10) the much greater planned concentration on areas of demonstrated research strength and (par 28-32) the growth of selectivity within departments.

1.4. Selectivity, concentration and collaboration

Policy debate around the ideal structure for an internationally competitive research base continued through the 1990s after the introduction of the cyclical university Research Assessment Exercise (RAE). The RAE had itself heightened the focus on research activity and management in institutions. This was already leading to some concern that the balance of primary T and R missions has been disturbed.

One concept much debated was that of 'critical mass'. The hypothesis was that small departments would have too little in either capital or intellectual resources to support sustained research excellence. The outcomes of RAE1992 and RAE1996 tended to show that the largest units were more typically associated with high grades. In fact, once adequate data on research performance became available through citation databases after 2000, analysis carried out for the Higher Education Funding Councils confirmed that while few large academic departments performed poorly, there were many small units that performed extremely well. Indeed, there appeared to be a growth pattern so that units that did well in research then expanded and grew teaching programmes.[11]

There was little doubt that the emphasis on the selective distribution of resources through an equitable process of research assessment did stimulate institutional

[11] Adams, J., Cook, N., Law, G., Marshall, S., Mount, D., Smith, D., Wilkinson, D., Bayers, N., Pendlebury, D., Small, H. and Stephenson, J. (2000). The role of selectivity and the characteristics of excellence - report of a consultancy study for the Higher Education Funding Council for England. HEPU, University of Leeds. 72 p. ISBN 0 85316 211 5; Adams, J. and Smith, D. (2002). Maintaining Research Excellence and Volume. A report to the Higher Education Funding Councils. URL: http://www.hefce.ac.uk/pubs/rdreports/2002/rd08_02

research management improvement[12]. Nationally, continuing analysis through the next two decades found rather little change at either institutional or regional level[13].

The greatest influence on the systemic profile of research activity during this time was the rise of international collaboration. Around 5% of U.K. research output had an international co-author in the 1980s. The 1990s saw this change with the reduced cost of travel to international conferences and the growth of easy international communications via the Internet. Initially this was usually pairwise, bilateral activity but multilateral collaboration became increasingly common in the 2000s[14].

Collaborative work has long been associated with higher impact. It is usually assumed that this is because researchers collaborate in order to solve more challenging problems, and this brings together multiple competencies as well as focussing greater resources. International collaboration appears to enhance this scenario further, delivering the most impactful work published in research journals. The most innovative research enterprise has become global and cross-border.

1.5. Summary

Research resources have been selectively distributed in the UK throughout the history of public research funding to meet a balance of research excellence, as evaluated by peer expertise, and government priorities, as determined by specific programmes. This has been achieved by a combination of agreed priorities shared between parties and the work of expert groups aiming to sustain the very best research in their field. The outcome has been a relatively concentrated distribution of funds that has changed rather little despite changes in assessment and evaluation.

Where more interventionist approaches have been advocated there has been an important history of experience to be borne in mind.

First, an appropriate evidence base is essential to test hypotheses that a problem exists and that an intervention is either required or likely to achieve the stated objectives. The example of the 'critical mass' hypothesis is one for which the advocates continued to promote the idea even when analysis showed it had no foundation. This happened because the idea based on hearsay became embedded without relevant data gathering and thus a lack of any prior analysis.

Second, the cost of intervention needs to be considered. This is true at two levels: structural change in the Earth Sciences was phenomenally expensive; but the human cost was also bigger than anticipated. If changes to the location of departments are required to meet the aims of co-location and concentration then the researchers must also move, along with their families, and this may prove unacceptable.

Third, interventions are inevitably based on past track record. This carries evident risks in missing innovation while consolidating established centres. It is an advantage of a university-based research system, compared to an institute that is mission-based, that it is innately flexible through self-direction and the turnover of researchers in training. This flexibility is lost when external restructuring is imposed.

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[12] Adams, J., Mount, D., Smith, D. N. and Taylor, R. (2005). Impact of selective funding of research in England, and the specific outcomes of HEFCE research funding. A report to HEFCE by Evidence Ltd. Smith, D. N., Adams, J. and Mount D. R. (2007). UK Universities and Executive Officers: The Changing Role of Pro-Vice-Chancellors, 56 pp. Leadership Foundation for Higher Education, London. ISBN 978-0-9553788-6-7; Smith, D. N. and Adams, J. (2008). Academics or executives? Continuity and change in the roles of pro-vice-chancellors. Higher Education Quarterly, 62 (4), p. 340-357.

[13] Adams, J., Rogers, G., Smith, D. N. and Thomson, S. (2009). Monitoring research concentration and diversity: changes between 1994 and 2007, p 24. Universities UK, London; Adams, J., Sheridan-Jones, B. and Thomson, S. (2011). Funding research excellence: research group size, critical mass and performance, pp. 40. ISBN 978 1 90819 008 6. http://www.university-alliance.ac.uk/2011/07/funding-research-excellence-research-group-size-critical-mass-performance; Adams, J. (2013). The fourth age of research. Nature, 497, p. 557-560; Adams J, Grant J, Smith D N and Szomszor M. (2024). Regional research capacity: what role in levelling up? Higher Education Policy Institute report no 168, HEPI, Oxford. https://www.hepi.ac.uk/reports/regional-research-capacity-what-role-in-levelling-up

[14] Adams, J. (2013). The fourth age of research. Nature, 497, p. 557-560.

2. Regional analysis

Analysis shows that research portfolios at the level of the major UK regions are found remarkably similar. All regions maintain activity across a broad range of disciplines, and none exhibit a narrowly concentrated profile. This is likely to be a natural consequence of any large region containing many institutions, leading to an organic diversity. However, some structural differences emerge at finer geographic resolution. While some regions combine relatively specialised institutions with diverse regional research portfolios, others achieve similar levels of diversity through the scale and breadth of a small number of major universities.

2.1. Broad regional subject profiles

To provide a helicopter view at regional level, the data were initially collated by the 22 Essential Science Indicators (ESI) subject categories used in Clarivate's InCites product (Table 1a-c, Appendix 2: Table 1a-c). These lack detail on social sciences and humanities but do cover a general view across science and technology and thus provide a useful starting point for understanding the broad structure of that part of the UK research system where resources are particularly concentrated. Other reports indicate that humanities and modern languages, where research impact is less well captured by publication databases, may have lost some diversity.[15]

Each iteration of Table 1 is a matrix by region and ESI research category that shows the percentage of each region's total research output that falls in each category. The iterations cover the five-year periods 2001-05, 2011-15 and 2021-25.

Analysis at International Territorial Level (ITL) 1 regional level (largest areas defined in the UK standard system) shows the degree of similarity across regions. All regions maintain research activity across most major subject areas, and no region exhibits a narrowly concentrated profile dominated by only a small number of disciplines. This confirms that the UK retains a breadth of research capability across its constituent regions, despite potential differences in institutional composition and size.

Some regional distinctions are nevertheless apparent. London has a particularly strong concentration in Clinical Medicine and several biomedical disciplines, consistent with the high density of major research-intensive universities, medical schools and NHS-affiliated research organisations. The cost of that relative surplus in biomedical research is seen in diminished relative activity in Plant & Animal Science, Geosciences and Space Science. This is a consequence of the cultural focus and relative availability of infrastructure in the UK's capital.

Scotland has relatively greater representation in several life science areas, including Plant & Animal Science, while the South West has comparatively strong activity in Environment/Ecology. Other regions exhibit modest emphases in areas such as engineering, materials science and the physical sciences, but these differences occur against a backdrop of otherwise broadly comparable subject portfolios.

Regional (ITL 1) differences are best characterised as moderate variations in emphasis rather than fundamentally different research structures. While some individual regions show an affinity for particular subjects, the successive tables suggest that the broad balance of activity remains steady across the UK. At this level of aggregation, regional research portfolios appear more similar than different.

[15] A British Academy report (10 September 2025) suggested that there are cold spots in the provision of courses in SHAPE subjects (social sciences, humanities and the arts), particularly languages. Their analysis suggests that parts of the north, the south-west and the east of England were particularly affected, along with areas in Wales, Scotland and Northern Ireland.

Table 1a. Regional output, as % region's total by 22 ESI categories (2001-2005)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	25.1	2.17	4.56	6.57	2.42	3.84	1.40	5.91	3.93	1.20	1.90	2.94	7.34	4.15	1.91	2.22	1.56	4.77	2.51	2.59	10.7	0.29
Eng	25.3	2.24	4.69	6.75	2.40	3.77	1.30	5.85	3.44	1.04	1.82	2.99	7.41	4.24	1.98	2.18	1.53	4.75	2.61	2.68	10.7	0.31
Sco	24.5	1.97	3.92	6.49	2.54	4.69	2.25	6.70	7.75	1.84	2.70	2.80	6.88	3.05	1.89	2.20	1.63	4.12	1.59	1.80	8.46	0.24
Wal	24.7	1.47	4.16	4.20	2.45	3.91	1.46	5.00	5.46	1.77	2.91	4.56	6.75	5.51	1.66	1.75	1.24	4.71	2.21	2.56	11.5	0.12
NI	25.2	1.54	2.49	7.40	2.22	2.58	1.79	4.55	4.54	3.52	2.26	2.07	7.88	3.26	3.26	2.81	0.92	5.82	3.14	2.00	10.7	0.07
NW	23.7	1.54	3.11	8.21	2.15	2.97	1.13	5.70	3.49	0.75	2.08	2.70	7.47	4.66	2.78	2.59	1.62	5.91	3.95	2.81	10.5	0.17
East	13.8	1.19	4.52	11.4	1.33	5.17	1.18	7.29	4.22	1.47	2.26	4.10	8.83	3.17	4.99	2.22	1.70	5.45	3.51	2.67	9.02	0.53
WM	28.3	1.83	3.32	7.31	2.32	2.56	1.51	5.52	1.97	0.59	1.33	1.59	6.81	4.82	1.76	1.88	1.85	4.42	3.31	4.06	12.8	0.17
Lon	34.4	3.67	7.18	4.56	2.83	4.31	1.24	5.46	1.88	0.55	1.07	1.60	4.31	5.54	1.36	1.69	1.03	3.16	1.66	2.39	9.83	0.30
SW	18.6	1.18	4.22	8.08	2.03	2.30	1.29	5.76	6.08	1.25	2.27	4.33	10.0	4.30	1.22	2.26	1.94	5.26	2.45	2.58	12.3	0.29
EM	26.2	1.40	3.52	4.93	3.32	2.84	1.01	4.94	2.48	1.21	1.20	2.51	8.58	4.19	2.81	1.97	1.78	7.36	3.10	4.14	10.4	0.15
SE	17.7	2.48	4.26	9.69	1.66	3.95	1.40	6.17	3.19	1.34	2.00	4.70	8.79	4.17	2.52	2.62	2.03	4.69	2.10	2.41	11.6	0.44
NE	25.2	0.96	4.97	7.48	1.57	3.12	0.98	4.08	3.08	0.86	2.03	3.77	11.01	4.06	3.38	2.06	1.01	3.76	2.35	2.03	12.0	0.22
YH	25.6	1.16	2.63	6.14	2.10	2.96	0.91	6.21	3.42	0.68	2.52	2.88	9.84	4.03	1.53	2.57	1.66	5.45	3.76	2.44	11.3	0.23

Table 1b. Regional output, as % region's total by 22 ESI categories (2011-2015)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	27.3	2.92	4.70	5.03	2.08	3.54	1.15	4.39	3.54	1.05	2.59	3.01	5.54	4.73	2.02	1.88	1.63	4.84	2.35	2.87	12.6	0.28
Eng	27.8	3.02	4.81	5.02	2.07	3.52	1.06	4.33	3.22	0.94	2.46	3.02	5.40	4.80	2.07	1.82	1.61	4.73	2.42	2.95	12.6	0.28
Sco	25.2	2.47	4.12	6.30	2.12	4.19	1.89	4.91	6.36	1.39	3.61	3.38	5.86	3.78	2.41	1.70	1.51	4.39	1.56	2.12	10.5	0.25
Wal	26.2	2.50	4.85	3.62	2.13	3.15	1.21	3.45	3.93	1.45	4.24	4.13	4.88	6.50	2.09	2.11	1.18	5.37	2.03	2.89	11.8	0.23
NI	26.7	1.49	2.41	4.88	2.65	2.75	1.31	3.83	3.75	3.24	3.23	2.37	6.88	4.37	4.60	2.71	0.68	5.91	2.32	2.11	11.6	0.16
NW	27.0	2.98	3.04	6.15	2.48	3.37	1.07	4.18	3.05	0.78	2.64	2.71	5.94	4.86	3.03	1.80	1.67	4.73	2.86	2.99	12.5	0.19
East	19.4	1.68	4.90	7.75	1.31	5.20	1.19	5.54	3.34	1.11	3.00	3.30	6.15	4.03	4.94	1.70	1.69	5.27	3.09	3.34	11.7	0.40
WM	32.0	2.30	3.60	6.59	1.73	2.30	0.90	3.99	1.49	0.61	1.66	1.47	5.93	5.05	2.78	1.75	2.45	4.27	2.80	3.81	12.3	0.18
Lon	35.3	4.93	7.17	4.19	2.20	3.81	0.99	3.92	1.74	0.51	1.34	1.44	3.31	6.19	1.29	1.52	1.03	3.41	1.72	2.55	11.2	0.28
SW	21.2	1.53	3.72	6.25	1.38	2.68	0.89	4.22	5.91	0.75	4.88	5.74	6.12	4.87	1.41	1.74	2.09	5.08	2.57	2.92	13.8	0.33
EM	28.7	1.73	3.78	3.90	1.96	3.33	0.86	3.69	3.09	1.24	1.39	2.62	5.61	5.49	3.30	1.78	1.38	6.82	2.92	3.65	12.6	0.15
SE	21.4	3.07	4.75	7.57	1.32	3.80	1.03	4.70	2.86	1.11	2.74	4.52	5.72	4.82	3.11	2.02	2.07	4.11	2.25	2.96	13.6	0.39
NE	26.5	1.85	5.70	5.11	1.53	3.30	1.07	3.54	2.24	1.22	2.27	4.55	5.95	4.61	4.38	1.73	1.28	4.98	1.73	2.58	13.7	0.23
YH	27.8	1.42	2.84	5.67	2.08	2.76	0.74	3.94	2.72	0.88	3.42	3.88	6.64	4.09	1.51	1.89	1.26	5.55	3.08	2.91	14.8	0.20

Table 1c. Regional output, as % region's total by 22 ESI categories (2021-2025)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	27.0	2.31	4.11	3.83	1.95	2.58	1.13	3.57	3.01	1.31	3.88	3.04	4.56	4.73	2.06	2.62	1.58	7.92	3.26	3.40	11.9	0.24
Eng	27.8	2.42	4.23	3.81	1.92	2.59	1.10	3.53	2.79	1.22	3.73	3.01	4.43	4.83	2.09	2.53	1.53	7.62	3.27	3.47	11.8	0.25
Sco	25.4	1.84	3.41	4.64	1.80	3.03	1.54	3.78	4.92	1.37	4.96	3.64	4.64	3.87	2.67	2.31	1.70	7.96	2.51	2.61	11.2	0.24
Wal	25.4	1.89	4.33	3.01	1.89	2.25	1.15	3.14	3.59	1.63	5.51	4.00	4.64	5.31	2.17	2.81	1.16	8.60	3.07	3.16	11.1	0.17
NI	31.1	1.50	2.55	2.46	3.56	1.91	1.23	3.16	2.60	3.36	3.85	1.42	5.11	5.14	3.73	3.55	0.38	7.33	3.13	2.12	10.8	0.10
NW	28.3	2.42	2.62	4.58	2.37	2.34	1.16	3.09	2.64	0.98	3.87	2.58	5.33	4.42	3.06	2.61	1.34	7.87	3.67	3.03	11.5	0.22
East	21.6	1.64	4.78	5.29	1.10	4.34	1.35	4.61	3.04	1.07	3.92	3.17	4.43	5.07	4.48	2.36	1.66	7.11	3.64	3.20	11.7	0.40
WM	30.4	1.61	2.96	4.72	1.56	1.66	0.92	3.24	1.24	1.10	3.00	1.50	4.89	4.72	3.33	2.56	2.20	9.01	3.85	4.18	11.1	0.21
Lon	35.9	3.72	6.45	3.12	1.85	2.87	0.98	3.31	1.27	0.77	2.26	1.54	3.04	5.75	1.51	2.21	1.13	5.57	2.57	2.85	11.1	0.24
SW	21.7	1.32	3.38	4.26	1.20	2.47	1.10	3.36	4.73	1.24	6.75	5.58	4.16	6.01	1.59	2.26	1.85	7.37	3.16	3.47	12.8	0.28
EM	27.3	1.26	3.24	2.90	1.73	1.90	1.03	3.05	2.92	1.79	3.44	2.41	4.78	5.81	2.37	3.27	1.06	10.7	3.84	3.98	11.1	0.17
SE	22.8	2.87	4.18	5.83	1.43	2.70	1.19	3.88	2.33	1.30	4.08	4.15	3.93	5.68	3.41	2.36	1.84	5.87	2.75	3.81	13.2	0.31
NE	23.2	1.22	4.65	4.39	1.31	2.26	1.00	3.10	1.96	1.24	3.78	4.49	4.71	4.21	4.98	2.70	1.56	8.40	3.05	4.16	13.5	0.18
YH	28.4	1.26	2.52	4.12	1.92	1.87	0.75	3.20	1.81	1.46	4.35	3.99	5.07	4.43	1.65	2.25	1.10	9.00	3.55	3.69	13.4	0.18

Abbreviations used for ESI subject categories:

CLIN	**Clinical Medicine**	**GEOS**	**Geosciences**
IMMU	**Immunology**	**CHEM**	**Chemistry**
NEUR	**Neuroscience & Behavior**	**PHYS**	**Physics**
PSYC	**Psychiatry/Psychology**	**SPAC**	**Space Science**
PHAR	**Pharmacology & Toxicology**	**COMP**	**Computer Science**
MOLE	**Molecular Biology & Genetics**	**MATH**	**Mathematics**
MICR	**Microbiology**	**ENGI**	**Engineering**
BIOL	**Biology & Biochemistry**	**MATE**	**Materials Science**
PLAN	**Plant & Animal Science**	**ECON**	**Economics & Business**
AGRI	**Agricultural Sciences**	**SOCI**	**Social Sciences, general**
ENVI	**Environment/Ecology**	**MULT**	**Multidisciplinary**

Abbreviations used for regions:

UK	**United Kingdom**	WM	**West Midlands**
Eng	**England**	Lon	**London**
Sco	**Scotland**	SW	**South West**
Wal	**Wales**	EM	**East Midlands**
NI	**Northern Ireland**	SE	**South East**
NW	**North West**	NE	**North East**
East	**East**	YH	**Yorkshire and Humberside**

2.2. Regional diversity in detail

The ESI analysis (Table 1) gives a useful overview of regional activity, but its broad subject categories inevitably conceal some variation within disciplines. A region with a balanced ESI profile may still focus an unbalanced proportion of its activity within a relatively small number of narrower research areas. To examine this in greater detail, an indicator of specialisation, the Gini coefficient, was calculated on the finer granularity of the 254 Journal Subject Categories (JSC) in Clarivate's Web of Science.

Regions – ITL1

Figure 1 maps the diversity of research activity across the ITL 1 regions for the period 2021–2025. Lower Gini coefficients indicate a more even distribution of research activity across subject categories when compared with the UK background and therefore a more generalist research portfolio, while higher values indicate greater subject specialisation, where focus is on a smaller set of research domains. However, regional differences appear flat due to the number and range of institutions included in these large geographic areas, note that the scale of Figure 1 only extends to a Gini coefficient of 0.3, already very diverse. This is inevitable when many institutions are included in each region, as they are here.

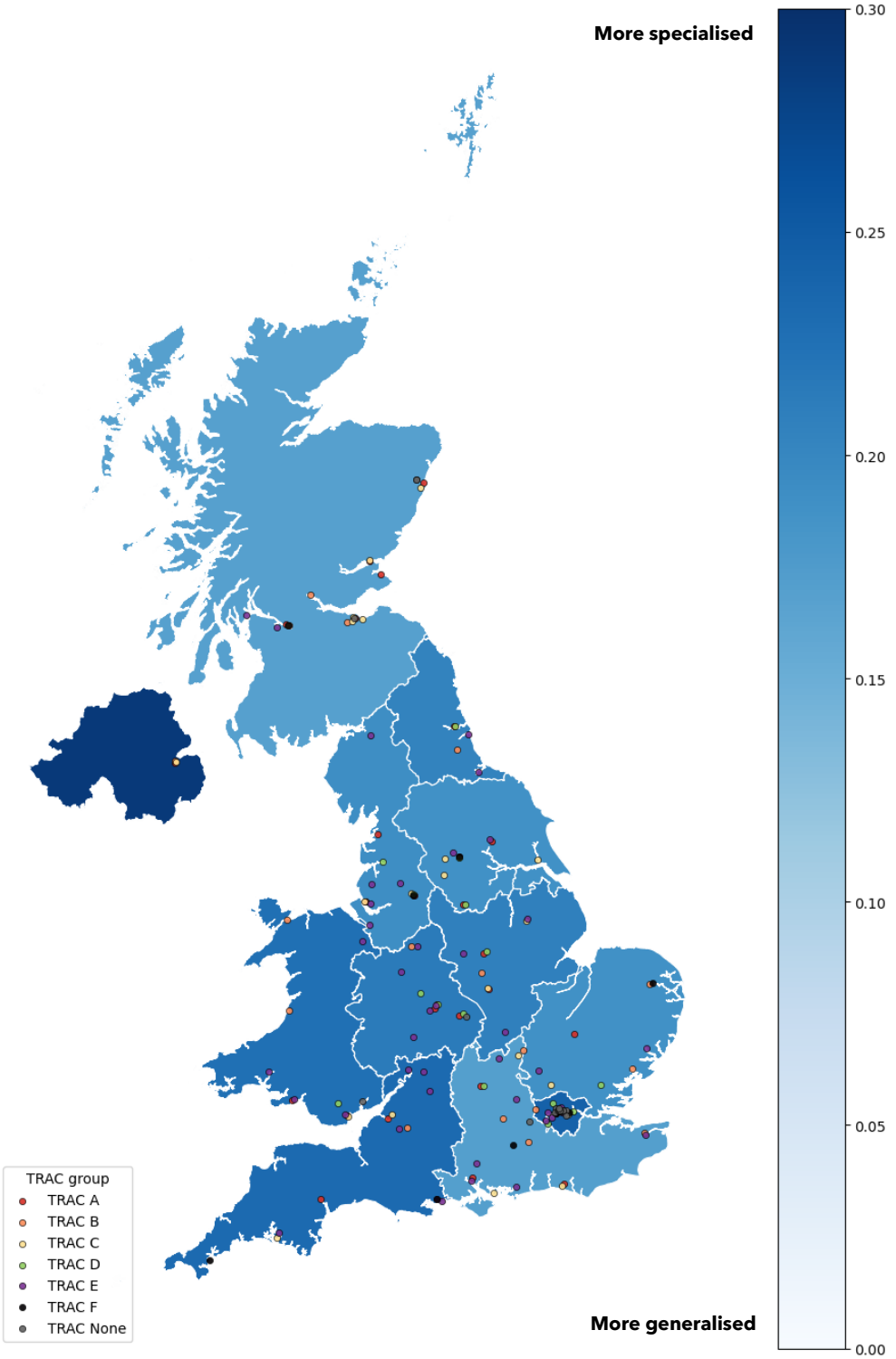


Figure 1 – Research specialisation as measured by the Gini coefficient across ITL 1 regions (2021-2025). ***Note: The figure also shows the main campus location and TRAC group of institutions. It should be noted that precise location data were not available for all institutions and that in major cities with more than one institution, data points overlap***

With the richer 254 JSC, variation emerges that was less apparent with the ESI profiles. Figure 2 (Appendix 2: Table 2) adds a time dimension to the ITL1 Gini coefficients with data in three periods as for Table 1: 2001-05, 2011-15, 2021-25. It reveals a consistent long-term tendency towards generalisation. In all cases regions exhibit lower Gini coefficients in 2021–2025 than in 2001–2005, so the trend across all regions is towards more generalised research portfolios.

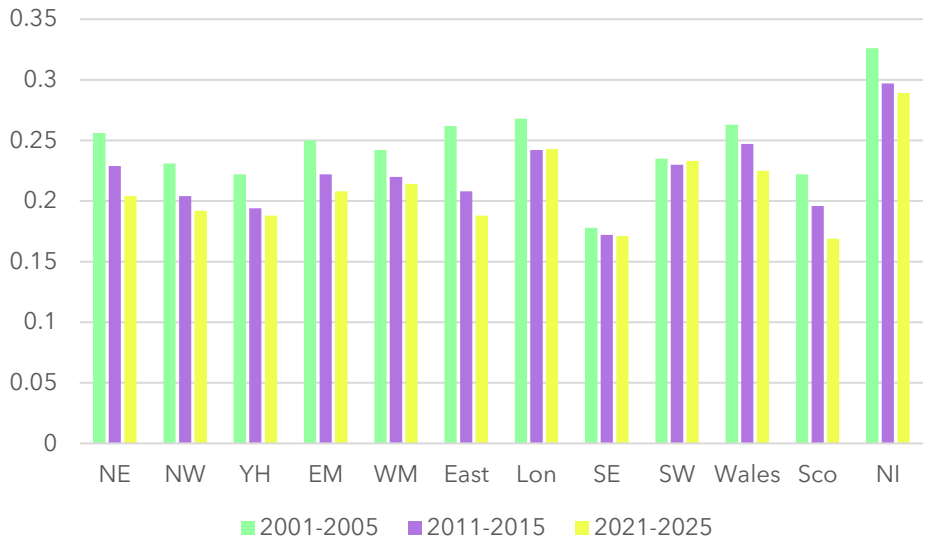


Figure 2 – Research specialisation as measured by the Gini coefficient across ITL 1 regions and over three time periods

Sub-regions – ITL2

We increased the resolution of the regional analysis by looking at the smaller ITL2 regions, shown in Figure 3. At this sub-regional level there is far greater variation. The range of values observed at ITL2 is substantially larger than that seen at ITL1 level, note the scale of the figure runs from 0 to 1 in this case, indicating that the differences in UK research diversity occur below the scale of the major regions.

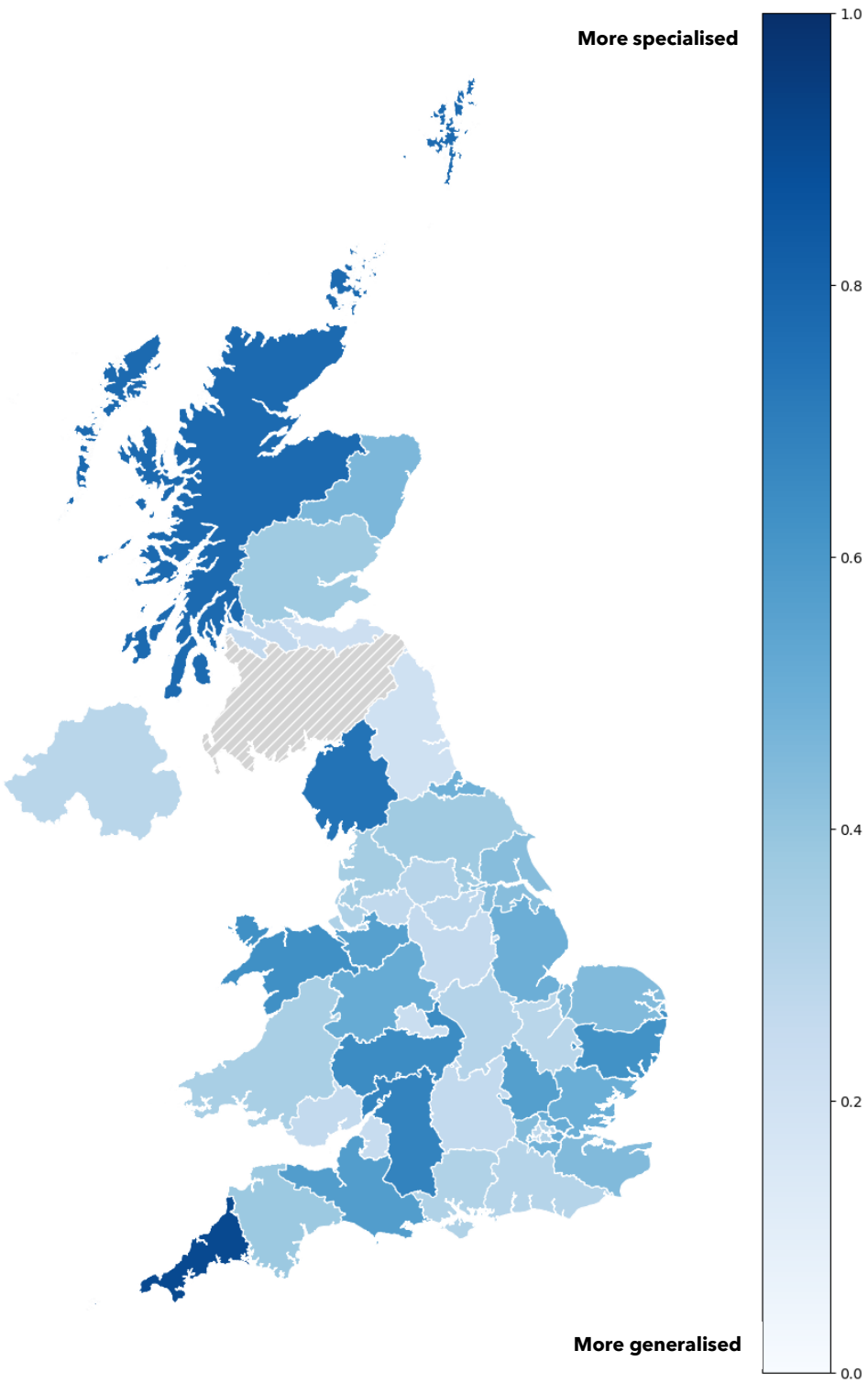


Figure 3 – Research specialisation as measured by the Gini coefficient across ITL 2 regions (2021-2025)

The diversity of a region does not necessarily correspond to the number of regional institutions. Some regions with relatively few institutions exhibit diverse research portfolios, while others with a wider institutional base appear more specialised. This suggests that regional diversity reflects not only the number of institutions present, but also the balance and interaction of their research strengths.

While the initial ESI analysis emphasised the commonality of regional research portfolios (Table 1), the JSC ITL2 analysis draws out differences in the structure of regional research systems. The following section explores some of these differences in more detail and considers how regions may arrive at similar levels of diversity through different institutional configurations.

2.3. Different pathways to regional diversity

The preceding section showed that substantial variation in research diversity exists between UK regions once research activity is examined at the level of Journal Subject Categories (JSC) and at the ITL2 regional resolution. An additional question is how that diversity arises. A region may exhibit a broad research portfolio because its constituent institutions are themselves relatively diverse, because specialised institutions contribute different research strengths, or because one or more large institutions dominate the regional profile.

Figure 4 (Appendix 2: Table 3) compares regional Gini coefficients with the average institutional Gini coefficient for each ITL2 region. The regional Gini summarises the diversity of research activity across the region as a whole, while the institutional value summarises the average level of specialisation among the region's institutions. Note that the institutional average is intentionally unweighted so as to reflect the composition of institutions within a region rather than the distribution of publication output. Consequently, institutions with small output volumes contribute equally to the institutional average as those with large output.

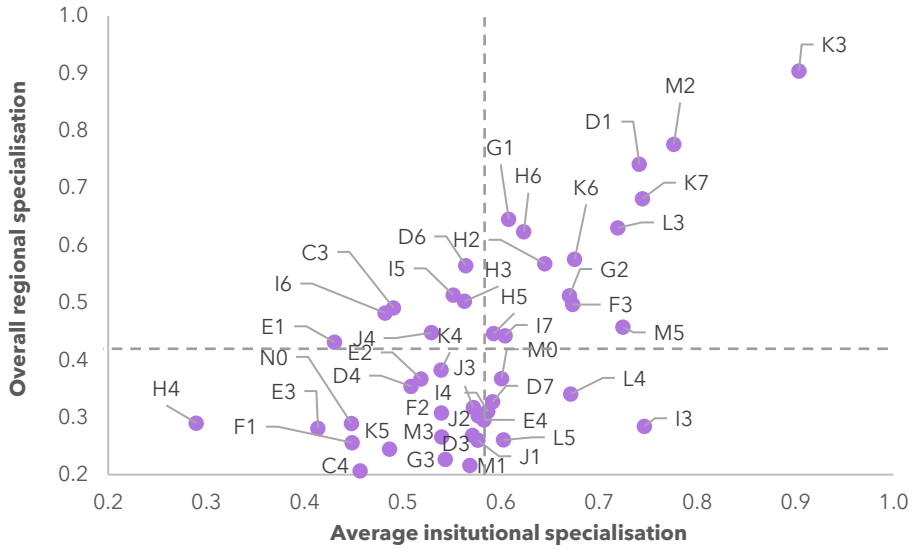


Figure 4 – Relationship between institutional and regional research specialisation across UK ITL2 regions (2021–2025). ***Note: The average value for the x-axis is 0.584 and for the y-axis is 0.421. The axes scaling is made different for improving data points visibility. Regional abbreviations are in Appendix 2: Table 3.***

A handful of broad patterns emerge. Regions towards the lower-left of the figure combine relatively diverse institutions with diverse regional research portfolios. Regions towards the upper-right are more specialised both institutionally and regionally.

The scarcity of regions in the upper-left reflects the difficulty of constructing a highly specialised regional profile from institutions that are themselves broad in disciplinary scope. The most interesting stories are those surrounding regions located towards the lower-right, where relatively specialised institutions coexist with comparatively diverse regional portfolios.

At first glance, regions in the lower-right quadrant might be seen as evidence of complementary specialisation, where institutions contribute different areas of research expertise that collectively generate a broad regional portfolio. However, the Gini analysis alone is insufficient to establish this mechanism. Similar positions within the plot may arise for very different reasons. To examine this in greater detail, Table 2 reports the mean pairwise cosine similarity (discussed in detail in Section 5 on Research Portfolio Similarity) between institutional research portfolios for a small number of illustrative regions. Lower similarity values indicate institutions with more

distinct research profiles, while higher values suggest greater overlap between institutional strengths.

Table 2. Pairwise cosine similarity by illustrative regions

Region	Institutions	Mean Institutional Gini	Regional Gini	Mean Similarity
Inner London - West	20	0.746	0.284	0.222
Berkshire, Buckinghamshire and Oxfordshire	5	0.577	0.260	0.509
East Central Scotland	5	0.569	0.216	0.415
South East Wales	4	0.603	0.260	0.328

Inner London-West provides perhaps the clearest example of a differentiated regional research ecosystem. Despite having one of the highest average levels of institutional specialisation (0.746), the region itself remains comparatively diverse (0.284). At the same time, it records a notably low average institutional similarity (0.222), suggesting that regional institutions occupy distinct positions within the research landscape. This pattern is consistent with the unique concentration of universities, specialist colleges, medical schools, cultural institutions, government organisations, financial services and creative industries found within the capital. This is an exceptional environment within the UK and despite substantial specialisation at institutional level, this network collectively appears to support an exceptionally broad regional research portfolio.

The devolved nations provide further examples of this relationship. Both East Central Scotland and South East Wales exhibit low levels of regional specialisation combined with relatively higher levels of institutional specialisation. In both cases, institutional similarity is substantially lower than might be expected if universities were pursuing highly overlapping research portfolios. These results suggest that regional diversity may, at least in part, emerge through a combination of differentiated institutional strengths rather than through uniformly broad institutions. However, the patterns are less extreme than those observed in Inner London-West and the current evidence should therefore be interpreted cautiously.

Berkshire, Buckinghamshire and Oxfordshire highlights the importance of exercising such caution. The region occupies a similar position to East Central Scotland and South East Wales within the Gini analysis and exhibits one of the lowest regional Gini coefficients in the UK. However, the average similarity between institutions is noticeably higher. This suggests that the broad regional profile cannot automatically be attributed to complementary specialisation. An alternative explanation is that the region's diversity is heavily influenced by the scale and breadth of a small number of exceptionally productive institutions, most notably the University of Oxford. In this case, regional diversity may reflect institutional scale as much as institutional complementarity.

These examples suggest that regions with similar levels of aggregate diversity may arrive at similar outcomes through markedly different configurations. Inner London-West appears to be characterised by a highly differentiated institutional ecosystem, while Berkshire, Buckinghamshire and Oxfordshire demonstrates that similarly diverse regional portfolios can emerge through the influence of exceptionally large and broad-based institutions. The examples from East Central Scotland and South East Wales suggest an intermediate position in which regional diversity may be supported by a combination of differentiated institutional strengths within comparatively compact research systems.

3. Research excellence

Research excellence broadly follows the pattern observed for overall research activity. Although highly cited research is somewhat more concentrated than institutional publication portfolios as a whole, the difference has diminished over time. Institutions that have become more diverse in their overall research activity have generally also become more diverse in the distribution of their highest-impact research. Excellence therefore appears increasingly distributed across a broader range of disciplines within institutions rather than being confined to a few subject areas.

In line with prior studies, there is little support for the assumption that research excellence is inherently associated with narrow institutional specialisation. Broad and multidisciplinary institutions are able to sustain excellent research across a wide range of subjects, while more specialised institutions continue to make important contributions in focused areas. Specialisation, diversity and excellence therefore appear to be compatible characteristics of the UK research system rather than competing objectives.

3.1. Excellence within institutional research portfolios

The preceding analyses examined subject diversity at the level of the UK regions and their constituent institutions, using each university's full portfolio to derive indicators. This provides useful insights on institutional research breadth, but it does not highlight variation within the institutions themselves. A university may produce research across many subject areas while its strongest research performance may be focused within a smaller number of departments, centres or disciplinary strengths.

Assessing specialisation within a university, that is to say, in smaller departmentally delineated or cross-department groups, is challenging because information on those internal structures is not consistently available in publication metadata. However, it is possible to explore this question indirectly by examining the subset of publications that belong to the global top 10% by citation impact.

If research excellence is focused within a relatively small number of research domains, the subject distribution of highly cited publications would be expected to be much more specialised than institutions' publication portfolios as a whole. Conversely, if excellent research is broadly distributed across the same areas in which institutions already publish, the diversity profile of highly cited outputs should resemble that of the overall publication portfolio. This notion is sound, but we will need to take care over how we interpret indicators as the volume of publications may become small for some organisations.

Figure 5 and Figure 6 compare the distribution of institutional Gini coefficients calculated using all publications and the subset of publications belonging to the global top 10% by citation impact. In both cases, the overall pattern is remarkably similar. Institutions exhibit a wide range of research profiles, from relatively broad portfolios through to highly concentrated subject specialisations, and the distributions shift steadily towards lower Gini values over time, where higher values are more specialised and lower more generalist. This indicates that institutions have become more generalist irrespective of whether all publications or only highly cited publications are considered.

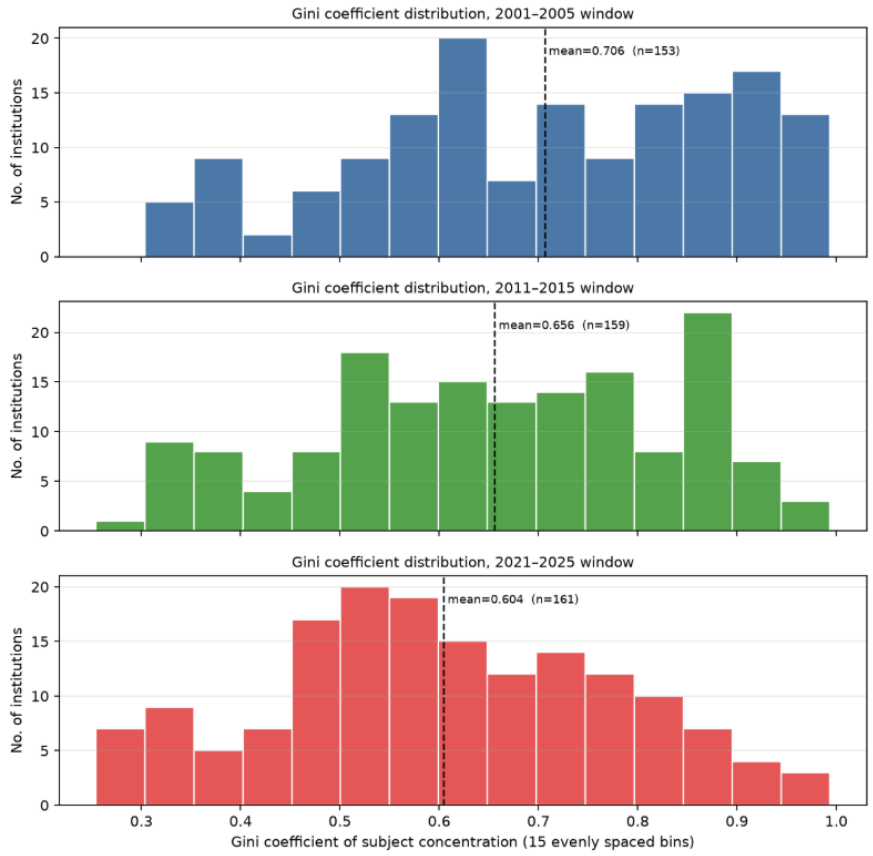


Figure 5 – Distribution of institutional Gini coefficients across all publications

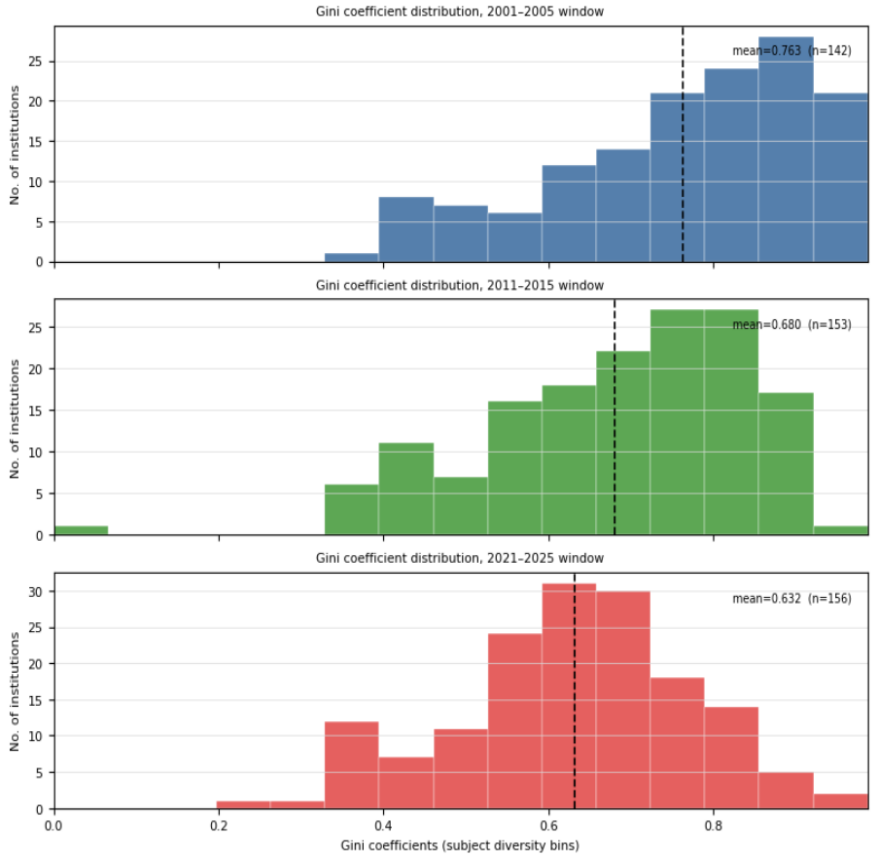


Figure 6 – Distribution of institutional Gini coefficients for top 10% publications by citation impact

There are, however, some notable differences. Across all three time periods, the distribution for highly cited publications is shifted towards higher Gini values, indicating that highly cited research tends to be somewhat more concentrated than institutional publication portfolios as a whole. This effect is most apparent in the 2001–2005 period, when many institutions exhibit highly cited portfolios associated with a relatively small number of subject areas. By 2021–2025, the distinction between the two distributions is less pronounced, suggesting that highly cited research has become more broadly distributed across institutional research portfolios.

It is also notable that this trend towards generalised institutions has occurred alongside rising citation impact. Figure 7 shows a sustained increase in the UK's Category Normalised Citation Impact (CNCI) over the same period. While no causal relationship should be inferred, the evidence does show that increasing institutional diversity has not been associated with declining research performance. On the contrary, the period in which institutional research portfolios became broader, their highly cited portfolios became broader and this coincided with a substantial increase in citation impact. Furthermore, highly cited research appears increasingly aligned with institutions' overall research portfolios, suggesting that excellence is becoming less concentrated within a narrow set of research strengths.

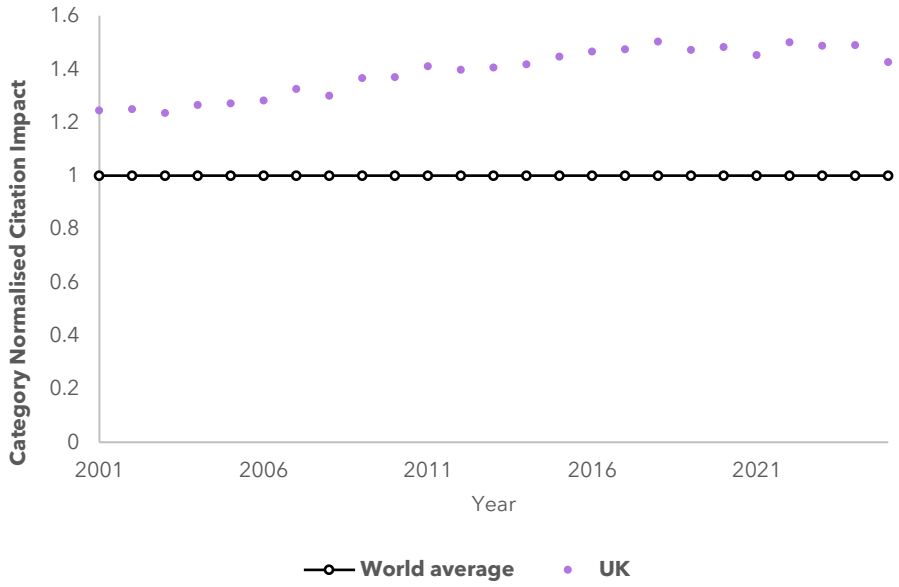


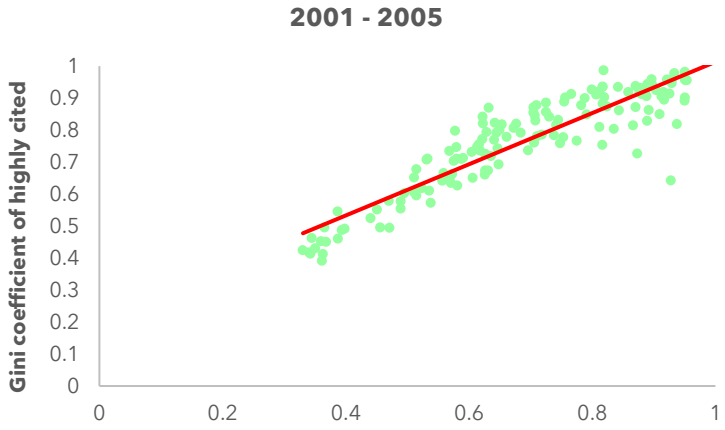
Figure 7 – UK Category Normalised Citation Impact (2001-2025)

While the histogram comparison speaks to diversity across the sector as a whole, it does not reveal whether individual institutions preserve similar levels of diversity when attention is restricted to highly cited research. Figure 8 therefore compares institutional Gini coefficients calculated using all publications with equivalent values calculated using publications belonging to the global top 10% by citation impact.

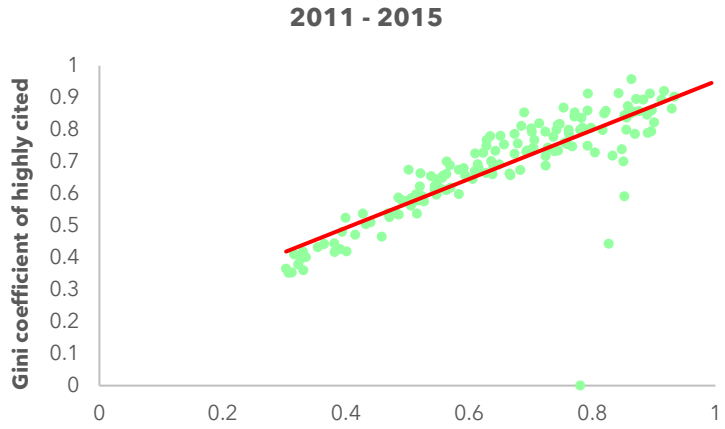
The resulting relationships are strong across all three periods examined (R^2 = 0.82, 0.68 and 0.75 respectively). Institutions with broader publication portfolios generally maintain broader portfolios of highly cited research, while institutions with more concentrated publication profiles tend to exhibit correspondingly concentrated portfolios of highly cited outputs. The relative diversity of institutions is therefore largely preserved when attention shifts from research activity overall to highly cited research.

At the same time, the fitted relationships sit consistently towards the upper-left of Figure 8. Highly cited research is therefore generally more concentrated than research activity overall, even among institutions with relatively diverse publication portfolios. This observation is consistent with the view that research excellence often emerges from particular areas of institutional strength. However, the effect is modest in comparison with the strength of the overall relationship. Institutions do not appear to undergo a fundamental shift in their diversity profile when attention is restricted to

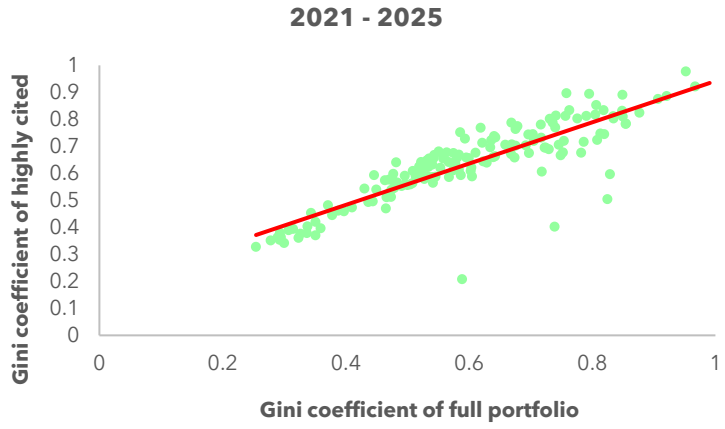
highly cited research. More diverse institutions remain relatively broad, specialist institutions remain relatively specialised, and the degree of concentration observed in highly cited research continues to reflect the wider structure of institutional research activity.



(a)



(b)



(c)

Figure 8 a-c – Gini coefficients of total output to number of top 10% most cited documents, by 5-year windows

3.2. Implications for diversity and excellence

The analyses presented in this chapter provide limited evidence that increasing institutional specialisation is a prerequisite for research excellence. While highly cited research is inevitably more focused than research activity overall, broad institutional research portfolios continue to support broad portfolios of highly cited research. Furthermore, the diversification of institutional research activity observed since 2001 has occurred alongside rising citation impact rather than declining performance.

Excellence and diversity should not be viewed as competing objectives. Research excellence appears increasingly distributed across institutions´ wider research portfolios rather than being confined to a small number of narrowly defined strengths. Specialist expertise undoubtedly contributes to research performance, but the evidence presented here suggests that broad-based institutional research portfolios remain entirely compatible with the production of a diversity of highly cited research.

4. Research collaboration and growth

There has been a very large rise in international research collaboration over recent decades. For UK universities, this rise accounts for the greater part of their growth in published output, and citation impact has also risen for most institutions. Institutional collaboration has generally been greatest in their well-established subject categories, but innovative exceptions are also seen, especially in AI and in environmental research. It is likely that collaboration-driven growth contributes to some of the rise in diversity in smaller institutions.

For larger research-intensive institutions, collaboration is most common with UK and international peers, particularly with older institutions in G7, EU and anglophone countries. Pre-92 institutions generally have a good national network across core areas and a broad spectrum of international links. Regional collaboration is more strongly evident among newer and smaller institutions, but their international links are growing, and some of their partners are in newer research economies.

4.1 Introduction

Research collaboration has increased over the last few decades. In the 1980s, it was rare for collaboration to occur across borders, but the Internet and falling travel costs enabled many to attend conferences and make new links. For the U.K. this has meant a rise since 1981 from less than 5% of output published in journals indexed in the Web of Science having an international co-author to around two-thirds being internationally co-authored, with higher frequencies in some leading research institutions.[16] Since 2010, there has been a general shift from bilateral towards multilateral collaboration.[17]

Collaboration is not cost-free since it requires a shared agenda and shared outcomes as well as benefitting from shared ideas and shared costs. It is therefore generally assumed that researchers collaborate where this enables them to tackle challenges they cannot solve alone. Previous analyses have shown that rising collaboration is associated with a rise in normalised citation impact (that is, compared to world averages for year and subject category). It is also likely to lead to diversification of research output since collaborators will likely have distinct areas of expertise.

Diversification of output through collaboration is an important factor in interpreting these analyses. We cannot, for a large cross-national sample and at reasonable cost, consistently identify the subject expertise of the researchers themselves, so we are using subject categorisation of high-quality publication output as a proxy that has universal currency. Collaboration may be enabling access to a wider range of expertise and also generating a wider range of outcomes than a unit within the U.K. research base would be able to do alone. It is thereby enabling U.K. research to grow at marginal cost, but it is not necessarily increasing the long-term diversity of any one U.K. institution, nor is it tying them into making an investment to achieve a subject diversity that might be of only temporary value.

While the growth of output in many areas and most institutions is associated with collaboration, that growth may also enable some entirely domestic subject diversity. Subject diversity will also be influenced by strategic management over the period, both to stimulate growth in innovative areas and to wind-up some more mature or less productive areas where subjects have been wound down over the period. The detailed effect of such internal institutional change, differing between locations, cannot be assessed within the boundaries of the current work.

[16] Adams J. (2013). The fourth age of research. Nature, 497, p. 557-560.
[17] Adams J., Szomszor M. (2022). A converging global research system. Quantitative Science Studies, 3(3), p. 715-731.

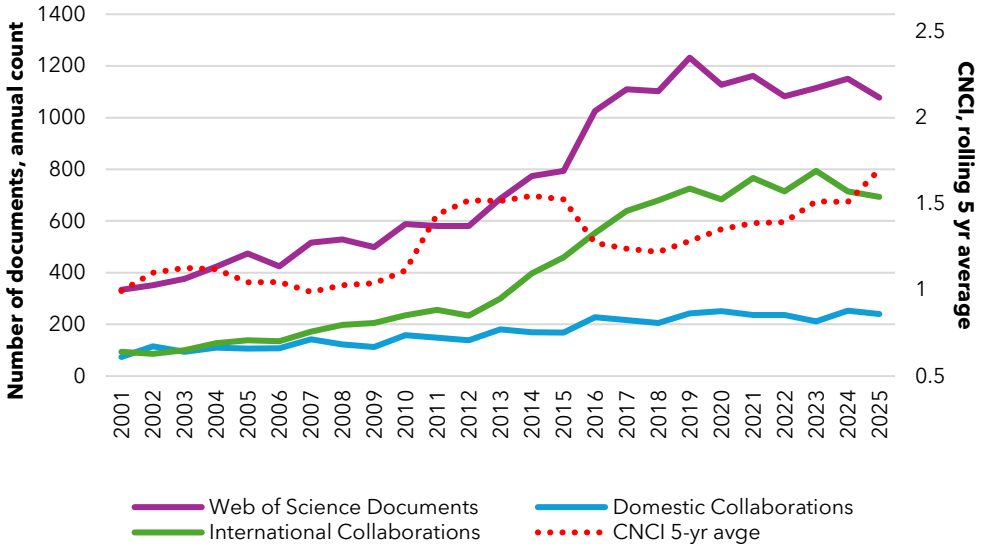
4.2 Graphs of institutional analyses

The collaboration analyses in this report are selective across a spread - by region and TRAC group - of institutions. The aim is to examine whether a signal of collaboration/diversity is detectable, or what other factors might emerge.

The analysis for each institution is presented in two graphs: these graphs are collated in Appendix 3.

The first graph of each pair is a time-based plot (2001-2025) showing changes in output (numbers of published documents as institutional total, international collaboration and UK-domestic collaboration) and the change in overall Category Normalised Citation Impact (CNCI), expressed as a running 5-year average because of annual variations among institutions with a smaller research output.

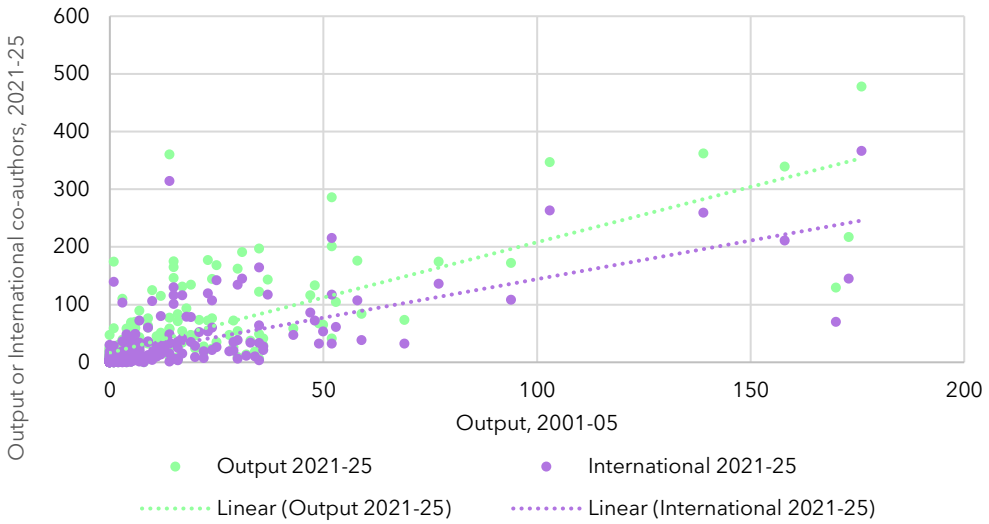
Example of Aston University



Appendix 3. Figure 1a – Research output trends across collaboration types and the CNCI trend of Aston University (2001-2025)

For this example, and for the majority of institutions analysed, total output has risen – and slightly fallen around COVID - on a track that closely parallels the rise in the numbers of papers with international co-authors. Impact, as CNCI, has risen in line with that rise in international collaboration. It was above the global average (which is 1.0) at the start of the period and continued a slow but steady rise to a recent plateau. The parallel tracks of total output and international collaboration in tandem with a relatively small change in purely domestic output, confirm that institutional growth is almost universally driven by collaborative activity.

The second graph is a scatterplot by Web of Science subject categories (there are 254 but few institutions publish in all) of total output in 2001-05 (x-axis) and total output in 2021-25 and the numbers of those 2021-25 papers that had an international co-author (y-axis). Thus, it shows both the spread of overall subject-based growth and the recent contribution of collaboration. To aid interpretation, each graph has a dashed linear plot to show the line of equality: all points falling below that line denote subject areas that had less output in 2021-25 than 2001-05. In most institutions, the majority of subject areas fall above the line, reflecting their growth.



Appendix 3. Figure 1b – Comparison of Journal Subject Category output of Aston University in two periods (2021-2025 and 2001-2005)

For this example, there has been strong growth across the subject range and while this is very variable it is most evident in areas where the institution was already strong in 2001-05. In some areas that have become a relatively greater part of the portfolio it is evident that a large part of that expansion has been driven by international collaboration. There are also some subject areas in the middle part of the size range that have contracted. In many smaller areas there is much less international collaboration although this has not prevented internal growth.

4.3 General overview

Collaboration is associated with change: it is evidently now a primary driver in the UK and wider international system, and it leads to more impactful research outcomes.

Analysis shows that it is often the case (with some important exceptions) that: collaboration is greatest in areas where an institution was already well established; a large part of output growth has been through collaboration (whether UK or partner-led is unclear); and growth is proportional across the spectrum. However, collaboration-driven growth seems to have contributed to at least some of the rise in diversity in smaller institutions, for example in innovative areas (AI, environment). Whether these emerged from existing research is unclear.

Collaboration patterns among the larger research-intensive institutions might be described as relatively conservative since they are likely based on emerging links in the 1990s. Current high-volume national collaborative links tend to be with similar organisations and when international they are with peers (that is, other research-intensive universities). Such links tend to be with G7, EU and anglophone countries and with institutions with well-established research profiles and international reputations. Links to China, South Korea and other growing and emerging research economies in Asia-Pacific only become important in the last few years.

This pattern broadly holds true for the other pre-92 institutions, which similarly will have been building international partnerships from an early point in the global growth pattern. This, they typically have a good national and regional network across their core areas, and a broad range of international links are frequent, though again Asia is less evident.

Regional collaboration within the U.K. is more strongly evident for post-92 and smaller institutions. However, it is among these institutions, which are also in the

process of building their international presence, that international links in their core areas have been established and are growing and there is more evidence of partnerships in new and emerging research economies such as South East Asia, the Middle East and Latin America.

4.4 Analytical commentary

Note that, as stated earlier, the commentary here is about changes in output grouped by subject category, which may or may not reflect changes in academic structure or staffing levels. Collaboration can be a valuable source of subject diversification without actual staff change on campus.

The four largest and most research-intensive institutions in the analysis were **Aberdeen, Birmingham and Cardiff universities, and Imperial College**. In every case, total output rose in parallel with growing international collaboration (a constant gap between total and collaborative output is the sustained volume of domestic activity) while CNCI rose in the middle period but has since plateaued, sometimes with marked annual variations given the institutions' sizes. Realistically, CNCI is more likely to plateau in this way as it moves ahead of world average.

Possible active strategic changes are marked by the number of small and intermediate sized categories that diminished slightly in each institution.

International collaboration was generally highest in those areas in which the institution was already most active. In subject categories with fewer outputs, the contribution from collaboration is more variable. At Birmingham, Surgery grew significantly with only moderate international collaboration, whereas Public & Environmental Heath at Imperial grew five-fold with a high level of international collaboration. At Cardiff, growth in medical areas (Psychiatry, Neurosciences, Clinical Neurology) is also linked to international collaboration. Cardiff also expanded Electrical Engineering and Computer Science (four-fold) and Energy & Fuels (ten-fold) with a high level of international collaboration. For Aberdeen, Environmental Sciences and Geosciences (and related topics) were areas that grew substantially with high levels of collaboration.

For these four, the most frequent domestic collaborators are other research-intensive UK universities, and for Aberdeen this list is strongly led by other Scottish universities.

International links are diverse and vary between institutions. Birmingham's most frequent international collaborators include many EU universities (especially in France, Germany and Italy) and the U.S. and Canada. Collaboration with Asia is has been less common, with some rise in the last decade. Imperial has a global network led by France (Paris Saclay, Sorbonne), Italy (La Sapienza, Padua) and the US (Harvard, Johns Hopkins) and similar institutions. Growth in international collaborations is driven by medicine and public health, and energy and climate, with new global partnerships emerging over the last 10 years. Collaboration with leading institutions across Asia has strengthened considerably over the past decade, with partnerships in key emerging research hubs growing rapidly and now contributing at levels comparable to many of Imperial´s more established international collaborations.

For Cardiff, north America (Harvard, Toronto, Caltech) and Australia (Melbourne, Monash) are the most frequent and there is also a wide-ranging EU network. In Asia, its most frequent links are the University of Hong Kong and Seoul University. Aberdeen stands out with a network of network organizations such as the CNRS (France), the Helmholtz Association (Germany), Consejo Superior de Investigaciones Cientificas (Spain), the University of California System and the Chinese Academy of Sciences.

Aston, Bangor and Brunel universities were included as representative of other pre-92 institutions. For all three, total output rises over the period lifted by growing

international collaboration. Citation impact is rising but more variable than for the larger institutions: for example, CNCI for Brunel rose from around world average to around 1.5 times that benchmark.

Growth at subject level linked to international collaboration is well evidenced. For Aston, a very large rise from a low base in Energy & Fuels is notable while growth and collaboration has been relatively higher in subject categories of medium size. Bangor's research in AI and Software Engineering expanded substantially, primarily driven by international collaboration. Growth in Ecology and in Environmental Sciences was exceptional and is strongly linked to international collaboration on the back of Bangor's track record over 50 years in, for example, Marine & Freshwater Biology. At Brunel, collaboration and growth in established areas is marked in Electrical Engineering and Materials Science, but collaboration also enabled Fuel & Energy to grow from a very small base.

Frequent collaborators are domestic with a clear regional network base for Aston (with Birmingham, Warwick and Nottingham) and Bangor (Cardiff and Liverpool). Brunel's collaboration is more evidently international, with many institutions in Italy and the U.S., although the most frequent collaborator is Imperial College. Aston has frequent collaborators in Asia-Pacific, as might be expected for a university with a reputation in a strong technology base. Bangor has a long list of international collaborators but fewer stand out as 'frequent'.

A diverse group of other universities were also included in the analysis (**Abertay, Coventry, Leeds Beckett, Leicester De Montfort, and UWE – the University of the West of England**). It is reasonable to assume that international collaboration is initiated or made more likely through international awareness and reputation. While some former Polytechnics had well-established strengths in niche areas, this was not the case across their full portfolios. For those U.K. institutions that became universities after 1992 there is likely to be a period during which this needs to be established, as their research portfolio grows and their publication presence expands. This works in two directions: visits to universities in Asia provide feedback that suggests that U.K. faculty are not always aware of the depth and quality of research elsewhere with which collaboration might be fruitful.

For all five institutions, total output rises over the period lifted by growing international collaboration. CNCI rose above world average in the middle period but more recent changes, and some annual fluctuations perhaps associated with retrenchment during the COVID epidemic are quite marked, can confuse indicative trends.

Changes in volume at subject level were varied. For Coventry and De Montfort, some small categories diminished slightly. There was a strong relationship for Coventry between growth and international collaboration in Electrical Engineering and Environmental Sciences, while Nutrition grew from almost nothing on the back of collaboration. De Montfort's research in AI and Software Engineering similarly expanded substantially, primarily through international collaboration. Its Electrical Engineering was well-established, and growth was less dependent on collaboration.

Leeds Beckett focussed on a small number of key subjects, while that output which fell into Engineering subject categories largely disappeared. Sports Science and Hospitality & Sport Tourism grew ten-fold and more than 75% of their output is now internationally collaborative. UWE's international collaboration is generally highest where the institution was already most active but substantial growth in Robotics, Automation & Control Systems and Materials Science is linked to collaboration. At Abertay, health and environmental sciences diminished over the period (formerly prolific subjects) while computer sciences were a principal growth area.

Frequent collaborators for these five are UK universities, particularly in the same or neighbouring regions: Coventry with Warwick, Birmingham, Leicester, Loughborough

and Aston; De Montfort with Leicester, Loughborough, Nottingham and Warwick; Leeds Beckett with Leeds, Hull, Sheffield, Sheffield Hallam and Newcastle.

Coventry has international links with Australasia (Deakin, Monash) and in the Middle East that have notably grown in the last decade. De Montfort's collaboration with China (Nanjing, Xiangtan, Zhejiang) expanded markedly after 2018. Leeds Beckett has significant collaboration with the University of Cape Town and the Australian Catholic University, almost entirely in Sports Science. UWE has sustained links with Toronto, Auckland and Melbourne universities. Abertay's most frequent collaborators are in Scotland, but international links are widely dispersed, notably in Australia.

These points are developed in commentary on specific institutions (Appendix 3).

5. Research portfolio similarity and institutional differentiation

The diversity and distinctiveness of institution research are not tightly linked. Many UK universities have broad research activity and, unsurprisingly, a similarity analysis indicates that substantial overlap exists between these broader portfolios, particularly among the older research-intensive universities. Increasing generalism within smaller and newer institutions has also seen them converging towards the UK background.

Diversity and differentiation, although related, are separate dimensions of the research system. Some diverse regions contain institutions with relatively similar research portfolios, while others derive diversity from a mixture of more distinctive institutional strengths. The strongest evidence of differentiation is often associated with institutions that maintain more specialised missions. The results suggest that the UK research system derives its long-term resilience and capability from a combination of broad-based institutions, synergistic strengths and specialised centres of expertise.

5.1. Similarity among research-intensive institutions

Previous sections showed that the UK's leading research universities typically maintain broad research portfolios spanning a wide range of disciplines. This section focusses on the composition of those research profiles at the institutional level. An indicator of research domain similarity, the cosine similarity, is calculated based on the 254 JSC research subject categories. This compares the publication counts in each category for institution X against the comparable counts for institution Y. This yields a number between 0 and 1 that reflects the 'similarity' of the publication profiles, where higher is more similar.

Figure 9 and Figure 10 provide pairwise cosine similarities for selected TRAC A and TRAC B institutions respectively during 2021-2025. Higher values indicate that institutions distribute their research activity across subjects in similar ways, while lower values suggest more distinctive research profiles. An illustrative sample is presented as the full matrices are too large to be shown in this report.

NAME	Liverpool School of Tropical Medicine	University of Sheffield	Cardiff University	Newcastle University - UK	University of Birmingham	University of Cambridge	University of Manchester	University of Oxford	Imperial College London
Liverpool School of Tropical Medicine	-								
University of Sheffield	0.296	-							
Cardiff University	0.294	0.911	-						
Newcastle University - UK	0.314	0.875	0.897	-					
University of Birmingham	0.313	0.914	0.906	0.922	-				
University of Cambridge	0.263	0.890	0.913	0.840	0.880	-			
University of Manchester	0.275	0.917	0.902	0.835	0.906	0.902	-		
University of Oxford	0.433	0.864	0.896	0.852	0.884	0.947	0.864	-	
Imperial College London	0.418	0.867	0.828	0.847	0.893	0.831	0.862	0.838	-
University of Edinburgh	0.349	0.894	0.906	0.868	0.890	0.940	0.870	0.940	0.839

Figure 9 – Pairwise research portfolio similarity among selected TRAC A institutions (2021-2025)

NAME	University of Stirling	Durham University	Loughborough University	University of East Anglia	Aberystwyth University	University of Reading	Aston University	Brunel University
University of Stirling	-							
Durham University	0.478	-						
Loughborough University	0.531	0.560	-					
University of East Anglia	0.770	0.505	0.509	-				
Aberystwyth University	0.591	0.659	0.549	0.619	-			
University of Reading	0.625	0.538	0.521	0.774	0.613	-		
Aston University	0.445	0.494	0.732	0.533	0.446	0.500	-	
Brunel University	0.481	0.641	0.866	0.501	0.619	0.516	0.779	-
University of Strathclyde	0.419	0.564	0.810	0.501	0.560	0.457	0.757	0.847

Figure 10 – Pairwise research portfolio similarity among selected TRAC B institutions (2021-2025)

Several patterns are apparent. First, many of the older, larger universities such as Oxford, Cambridge, Edinburgh, Birmingham, Manchester, Sheffield and Newcastle exhibit high levels of similarity from substantial overlap in their subject portfolios, reflecting their history as research-intensive institutions. This complements the findings presented earlier in the report where the Gini analysis showed that research heavy universities tend to maintain broad and generalist research portfolios. This is a natural relationship as the analytical definition of generalist is based on the UK national context. In other words, research heavy universities look largely like each other and the national background.

At the same time, the matrices also reveal examples of more distinctive institutions. Liverpool School of Tropical Medicine stands apart from the other TRAC A institutions, exhibiting substantially lower similarity scores than those observed among the large multidisciplinary universities. This reflects its obvious specialist focus and confirms that considerable differentiation persists where institutions are organised around a specific mission.

The TRAC B institutions display a similar but somewhat more varied pattern. Whilst there is still considerable overlap between institutions, a wider range of similarity scores is evident. This reflects the greater variety of institutional missions represented within the group, including universities that combine broad research portfolios with stronger areas of disciplinary concentration. For example, a focus on engineering, Brunel, Loughborough and Strathclyde share materials science whereas Stirling and East Anglia are similar to one another but somewhat distinct from others.

Research-intensive universities are characterised by internal generalism and external similarity. Stronger differentiation is generally associated with institutions that retain a more clearly specialist mission, contrasting with the comprehensive universities.

The strongest differentiation in the similarity analysis is found among specialist institutions. While many research-intensive universities are generalist in their subject portfolios, the specialist institutions represented within TRAC F display a much wider range of relationships. Some institutions with closely aligned missions exhibit very high similarity, while others have highly distinctive positions within the research landscape. This pattern is consistent with the role of specialist institutions in maintaining areas of expertise not widely replicated elsewhere in the sector.

5.2. Similarity within regional research systems

The regional analyses presented earlier demonstrated that similar levels of aggregate diversity can emerge through different institutional configurations. Diversity metrics alone, however, cannot reveal whether institutions occupy similar research spaces or contribute distinct areas of expertise. Similarity analysis therefore provides an additional perspective on how regional research capability is organised.

Figures 11-13 present similarity matrices for Berkshire, Buckinghamshire and Oxfordshire, Scotland, and Wales. These examples were selected because both regions exhibit relatively diverse aggregate research portfolios but differ in the role that institutional similarity appears to play in generating that diversity.

Scotland and Wales are ITL 1 regions, while Berkshire, Buckinghamshire and Oxfordshire are ITL 2, so they are not on the same regional scale, but here we are not directly comparing them.

Name	Buckinghamshire New University	Oxford Brookes University	University of Buckingham	University of Oxford
Buckinghamshire New University	–			
Oxford Brookes University	0.669	–		
University of Buckingham	0.377	0.481	–	
University of Oxford	0.398	0.600	0.623	–
University of Reading	0.440	0.617	0.366	0.520

Figure 11 – Pairwise research portfolio similarity among universities in Berkshire, Buckinghamshire and Oxfordshire (2021–2025)

Berkshire, Buckinghamshire and Oxfordshire provide an instructive contrast. In the regional diversity analysis, the region exhibited one of the lowest aggregate Gini coefficients in the UK despite a higher level of institutional specialism between institutions than was observed in some other diverse regions. The similarity matrix highlights the range of institution types in the region. Viewed alongside the diversity results we confirm a mix of institutional focuses, heavily influenced by the scale of the largest institutions.

The Scotland matrix illustrates a regional research system composed of institutions with both shared and distinctive characteristics. Major research-intensive universities are similar in their broad-based subject portfolios, reflecting their roles as comprehensive institutions. At the same time, clear differences remain visible between institutions, implying that regional capability is distributed across a range of research profiles rather than concentrated within a single university model. This observation is consistent with the interpretation of Scotland as a diverse and distributed research ecosystem.

NAME	Edinburgh College of Art	Edinburgh Napier University	Glasgow Caledonian University	Glasgow School of Art	Heriot Watt University	Queen Margaret University	Robert Gordon University	Scotland's Rural College	Scottish Agricultural College	University of Aberdeen	University of Abertay Dundee	University of Dundee	University of Edinburgh	University of Glasgow	University of St Andrews	University of Stirling	University of Strathclyde	University of West Scotland
Edinburgh College of Art	–																	
Edinburgh Napier University	0.358	–																
Glasgow Caledonian University	0.315	0.681	–															
Glasgow School of Art	0.747	0.376	0.387	–														
Heriot Watt University	0.333	0.740	0.528	0.267	–													
Queen Margaret University	0.223	0.332	0.729	0.335	0.162	–												
Robert Gordon University	0.331	0.782	0.627	0.338	0.737	0.321	–											
Scotland's Rural College	0.191	0.193	0.212	0.049	0.310	0.112	0.263	–										
Scottish Agricultural College	0.086	0.254	0.185	0.050	0.244	0.050	0.185	0.659	–									
University of Aberdeen	0.311	0.507	0.656	0.309	0.548	0.454	0.551	0.388	0.287	–								
University of Abertay Dundee	0.402	0.663	0.513	0.405	0.520	0.345	0.556	0.244	0.124	0.463	–							
University of Dundee	0.205	0.353	0.570	0.281	0.310	0.421	0.362	0.246	0.199	0.759	0.340	–						
University of Edinburgh	0.329	0.618	0.685	0.392	0.606	0.453	0.591	0.394	0.272	0.808	0.528	0.736	–					
University of Glasgow	0.285	0.680	0.722	0.356	0.622	0.433	0.602	0.306	0.261	0.764	0.472	0.719	0.894	–				
University of St Andrews	0.297	0.349	0.394	0.255	0.531	0.260	0.390	0.331	0.227	0.631	0.372	0.414	0.703	0.593	–			
University of Stirling	0.368	0.493	0.66	0.337	0.414	0.619	0.447	0.386	0.302	0.699	0.502	0.452	0.617	0.546	0.596	–		
University of Strathclyde	0.301	0.735	0.657	0.288	0.854	0.286	0.787	0.269	0.246	0.576	0.498	0.428	0.635	0.686	0.505	0.419	–	
University of West Scotland	0.378	0.810	0.684	0.341	0.760	0.399	0.739	0.325	0.314	0.554	0.692	0.394	0.680	0.673	0.513	0.600	0.775	–
University of the Highlands & Islands	0.284	0.266	0.330	0.166	0.378	0.274	0.288	0.385	0.314	0.595	0.248	0.311	0.386	0.332	0.503	0.699	0.303	0.392

Figure 12 – Pairwise research portfolio similarity among Scottish universities (2021–2025)

There has been some reorganisation of higher education within Wales, as there has been in England. Not all the analytical data available were consistent with the current institutional structure and some numbers refer to now-historical institutions.

The Wales matrix illustrates an even stronger divergence between institutions with the University of Wales Newport (the Newport Campus of the University of South Wales since 2013) is strongly differentiated from the rest of institutions, followed by the Swansea Metropolitan University (which became a part of the University of Wales Trinity Saint David since 2013).

NAME	Aberystwyth University	Bangor University	Cardiff Metropolitan University	Cardiff University	Swansea Metropolitan University	Swansea University	University of South Wales	University of Wales Newport	University of Wales Trinity St David
Aberystwyth University	–								
Bangor University	0.598	–							
Cardiff Metropolitan University	0.342	0.407	–						
Cardiff University	0.581	0.571	0.468	–					
Swansea Metropolitan University	0.062	0.086	0.297	0.117	–				
Swansea University	0.592	0.628	0.576	0.813	0.172	–			
University of South Wales	0.452	0.508	0.803	0.666	0.164	0.709	–		
University of Wales Newport	0.034	0.023	0.012	0.015	0.000	0.020	0.006	–	
University of Wales Trinity St David	0.382	0.363	0.460	0.387	0.463	0.449	0.454	0.082	–
Wrexham University	0.443	0.353	0.455	0.505	0.080	0.505	0.558	0.000	0.225

Figure 13 – Pairwise research portfolio similarity among Welsh universities (2021–2025)

Appendix 1: Methodology

Scope of data

Institutions: organisations classified as Academic and located in the United Kingdom (England, Scotland, Wales and Northern Ireland). Only top-level institution names are retained; constituent sub-units such as departments and sub-unit centres are excluded so that each institution is counted once.

Period: publications from 2001 to 2025 with a detailed analysis of three periods – 2001-2005, 2011-2015, and 2021-2025.

Dataset export: data on publications is exported from the Web of Science database in July 2026. The dataset naturally lags the most recent publications being indexed in the database, especially related to studies published in late 2025.

Counts: for every institution, year and subject category, the number of distinct publications assigned to that category. A publication assigned to multiple categories contributes to each of them (whole counting).

National benchmark: a UK aggregate profile is constructed in exactly the same way, pooling all UK academic output by year and category. This aggregate serves as the reference distribution against which every institution is compared.

Diversity

For each institution, the diversity measure is built in three steps and then summarised with a single coefficient. The steps below are applied independently to each time period (year or year grouping).

Step 1: Size discrepancies

Raw publication counts are first converted to subject shares. For an institution, each category's publication count is divided by the institution's total publication count for the period, giving the fraction of the institution's output that falls in each category. By construction these shares sum to one, which makes large and small institutions directly comparable.

$$\textit{subject share (category c)} = \textit{institution's publications in c} \div \textit{institution's total publications}$$

Step 2: The UK context

Each institutional subject share is then divided by the corresponding UK subject share for the same category and period, producing a relative specialisation value for every category:

$$\textit{relative value (category c)} = \textit{institution's share in c} \div \textit{UK's share in c}$$

A value of 1 means the institution publishes in that category at exactly the national rate; a value greater than 1 means it is over-represented relative to the UK (for example, a larger share in Mathematics than the UK as a whole places the institution above 1 for Mathematics); a value below 1 means it is under-represented.

This benchmarking step is what gives the measure its meaning. After it, an institution whose subject mix matches the UK exactly has a relative value of 1 in every category — a perfectly even profile. The further an institution's profile departs from the national pattern, the more uneven this set of relative values becomes.

Step 3: Gini coefficient

The spread of an institution's relative specialisation values across all categories is summarised with the Gini coefficient, a standard measure of inequality (evenness). For the vector of relative values x across n categories with mean $\bar{x}$, it is calculated as:

$$G = \Sigma_i \Sigma_j \left| x_i - x_j \right| \div \left(2 n^2 \bar{x} \right)$$

The coefficient ranges from 0 to (close to) 1. Because it is applied to the UK-baselined values, its interpretation is anchored to the national profile:

- Low Gini → diverse. Relative values are even (all near 1): the institution's subject distribution closely resembles the UK as a whole. An institution identical to the national profile scores 0.
- High Gini → specialised. Relative values are uneven: output is concentrated in a subset of categories that depart markedly from the national pattern.

Note: "diversity" here is defined as evenness relative to the UK environment, not as the raw spread of an institution's output. The measure therefore answers "how far does this institution depart from the national subject balance?" rather than "how many subjects does it work in?"

For each institution and each time period, the following sequence is applied:

- Count distinct publications by subject category.
- Divide by the institution total to obtain subject shares (Step 1).
- Compute the equivalent UK shares from the national aggregate.
- Divide institutional shares by UK shares to obtain relative specialisation values (Step 2).
- Compute the Gini coefficient across those values (Step 3).

Change over time

The measure is computed over time in two ways.

Annual series: The full pipeline is applied to each individual year from 2001 to 2025, producing an annual Gini time series for each institution. This captures fine-grained movement and would allow specific shifts to be related to known policy events (for example, the RAE and REF assessment cycles) if those events have an impact.

Five-year windows: To reduce year-on-year noise, which is more pronounced for smaller and more specialised institutions, the analysis is repeated over three five-year windows: 2001–2005, 2011–2015 and 2021–2025. Publication counts are aggregated across each window before shares; benchmarking and the Gini coefficient are computed. The three windows give comparable snapshots near the start, middle and end of the period for a "then versus now" comparison of changes in institutional specialisation.

Description of the dataset and the metrics used

Bibliometrics is the analysis of data derived from research publications and their citations. Publication of research outcomes is an integral part of the research process and is a universal activity and can therefore be used as an indicator of research activity. Authors then cite the publications they have found useful in their own work, and consequently frequently cited publications can be assumed to have been more useful than papers which are hardly cited at all. The number of citations received per publication, also known as the citation impact, is therefore an indicator of the academic impact of research (which is not the same as other forms of impact, such as

economic or social impact). Because the age of a publication (i.e., its publication date) and the field to which it relates also affect the number of citations it can be expected to have received, we normalize for these factors to give an indicator known as the category normalized citation impact.

The research publication data used for this project were sourced from the Web of Science Core Collection. This is a Clarivate-owned comprehensive database of research published in academic journals, books and conferences. It is widely acknowledged to be the world's leading source of citation and bibliometric data. The authoritative, multidisciplinary content covers over 22,000 of the highest impact journals worldwide, including Open Access journals and over 300,000 conference proceedings. Coverage is both current and retrospective in the sciences, social sciences, arts, and humanities, in some cases back to 1900. The Web of Science also includes patents and patent citation information derived from our Derwent World Patents Index database. The key features of the Web of Science Core Collection are:

- **Publisher-neutral curated quality:** A robust evaluation and curation process by a team of expert in-house editors, carefully selecting content for quality. This ensures our unbiased coverage is consistent and comparable across publishers, countries, and fields.
- **Our curation process is unique:** Using objectivity, selectivity, and collection dynamics as the basic principles of our selection process, we use a single set of 28 criteria to evaluate a journal's quality (24 quality criteria) and influence (4 impact criteria). These are dynamic collections, subject to continuous curation, to ensure journals continue to meet our editorial standards and are in the appropriate collection. We aim to identify and include high quality journals, while balancing subject and geographic coverage, and to promote research integrity.
- **Cover-to-cover indexing:** No other resource indexes as deeply and completely as the Web of Science Core Collection. All the journals that we select for inclusion in the collection are indexed cover-to-cover. For each paper, we capture all authors, all author affiliations, abstract and keywords (where present), funding acknowledgements, including agency and grant numbers (if provided), and all cited references.
- **Expansive multidisciplinary discovery:** The Web of Science Core Collection provides comprehensive coverage of the sciences, social sciences and arts and humanities across journals, books, and conference proceedings.
- **We are the world's original citation index:** Web of Science Core Collection provides cover-to-cover indexing across the world's highest-quality and most impactful publications.

Key methodological terms and concepts used in this document:

- **Location:** The metadata associated with publications indexed in the Web of Science includes the addresses researchers provide for their affiliated organizations. These metadata therefore allow us to link research to places (countries, states, cities etc.) and to research organizations (e.g., universities, hospitals, government organizations, companies).
- **Citations:** The citation count is the number of times that a citation has been recorded for a given publication since it was published. Not all citations are necessarily recorded since not all publications are indexed. The material indexed by Web of Science Group, however, is estimated to attract about 95% of global citations.
- **Journal Subject Categories:** All journals indexed in the Web of Science are assigned to one or more subject categories, and every article within that journal is subsequently assigned to the corresponding categories. Publications from prestigious, 'multidisciplinary' journals such as Nature, Science, The Lancet, etc. are assigned to specific categories based on journal categories associated with the references cited in the article. The journal

subject categories are used as a proxy for the subject matter of research. In this project, we used the OECD fields of research to analyse subject matter, this classification schema was operationalized as a mapping of these fields to the Web of Science Journal Subject Categories. In addition, the Essential Science Indicators (ESI) classification was used, which is limited to selective journals indexed in Science Citation Index Expanded and Social Sciences Citation Index of the Web of Science Core Collection.

Appendix 2: Data for Section 2

Table 1a. Regional output by 22 ESI categories (2001-2005)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	109445	9487	19902	28647	10559	16775	6109	25789	17127	5235	8298	12810	32038	18106	8337	9694	6802	20795	10938	11298	46828	1287
Eng	94169	8336	17460	25119	8928	14037	4845	21775	12800	3885	6752	11123	27578	15784	7346	8094	5686	17664	9696	9967	39743	1140
Sco	14501	1168	2323	3842	1504	2774	1335	3966	4590	1088	1597	1659	4073	1808	1117	1300	964	2439	940	1068	5011	141
Wal	4844	289	815	823	480	767	287	980	1071	348	570	894	1324	1080	326	344	244	924	433	502	2245	24
NI	2305	141	228	676	203	236	164	416	415	322	207	189	720	298	298	257	84	532	287	183	973	6
NW	9163	594	1202	3170	829	1149	435	2203	1350	290	805	1045	2887	1802	1074	1001	627	2283	1526	1085	4047	67
East	5359	464	1757	4437	517	2010	458	2837	1640	572	880	1597	3435	1232	1941	865	663	2121	1365	1040	3508	206
WM	7789	503	913	2012	638	704	415	1519	541	162	365	438	1873	1325	483	517	510	1217	910	1117	3512	46
Lon	37836	4041	7901	5020	3120	4739	1367	6005	2064	601	1177	1764	4742	6102	1498	1861	1137	3482	1824	2629	10816	329
SW	4730	301	1073	2055	516	584	329	1464	1545	318	577	1101	2552	1093	309	574	493	1338	623	657	3125	73
EM	7168	384	965	1352	910	778	276	1354	679	331	328	689	2352	1148	769	540	488	2017	850	1134	2844	40
SE	11878	1665	2859	6496	1115	2648	940	4137	2140	901	1344	3153	5890	2796	1688	1759	1359	3141	1407	1615	7797	293
NE	4525	172	894	1345	283	561	176	733	553	155	364	677	1978	730	608	371	182	675	423	365	2162	40
YH	9552	431	980	2289	784	1105	338	2313	1275	254	939	1074	3666	1503	571	959	617	2030	1400	910	4192	87

Table 1b. Regional output by 22 ESI categories (2011-2015)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	184643	19791	31810	34047	14072	23940	7801	29717	23940	7124	17511	20409	37491	32053	13668	12699	11024	32763	15930	19424	85285	1879
Eng	163614	17767	28261	29517	12185	20684	6207	25471	18947	5509	14464	17759	31747	28230	12181	10724	9462	27807	14225	17367	73940	1669
Sco	22506	2209	3679	5629	1891	3749	1693	4386	5686	1246	3225	3026	5242	3376	2156	1523	1348	3922	1391	1891	9406	221
Wal	8054	767	1491	1111	654	968	371	1059	1208	446	1302	1269	1499	1996	642	647	362	1649	623	888	3637	72
NI	3881	216	350	709	385	400	191	556	545	471	469	345	999	635	669	394	99	858	337	306	1691	23
NW	17747	1958	2002	4050	1635	2221	705	2749	2007	512	1739	1785	3912	3200	1994	1184	1098	3116	1882	1966	8227	123
East	12458	1075	3144	4975	840	3335	765	3552	2142	712	1928	2115	3943	2584	3167	1090	1085	3384	1980	2141	7488	257
WM	14717	1058	1652	3028	793	1058	415	1834	686	281	761	674	2726	2319	1276	806	1124	1961	1286	1750	5663	84
Lon	64689	9036	13159	7693	4039	6991	1818	7191	3196	940	2460	2643	6065	11358	2368	2792	1885	6250	3161	4669	20500	516
SW	9618	697	1691	2843	627	1218	403	1918	2687	341	2220	2607	2780	2215	639	793	948	2308	1168	1326	6262	148
EM	12236	736	1610	1662	833	1416	368	1573	1318	528	593	1116	2391	2336	1406	759	587	2906	1245	1554	5346	66
SE	23687	3409	5263	8397	1464	4217	1140	5216	3169	1232	3044	5015	6347	5347	3445	2238	2296	4554	2494	3286	15101	428
NE	7798	546	1680	1507	451	974	315	1043	659	359	669	1340	1755	1360	1290	510	378	1468	509	759	4035	68
YH	15693	802	1605	3209	1179	1562	419	2229	1541	499	1932	2193	3754	2311	856	1067	712	3139	1741	1644	8361	111

Table 1c. Regional output by 22 ESI categories (2021-2025)

	CLIN	IMMU	NEUR	PHYS	PHAR	MOLE	MICR	BIOL	PLAN	AGRI	ENVI	GEOS	CHEM	PSYC	SPAC	CAMP	MATH	ENGI	MATE	ECON	SOCI	MULT
UK	245123	21019	37354	34813	17738	23498	10307	32421	27399	11883	35250	27627	41495	43042	18755	23811	14359	72047	29632	30884	108519	2208
Eng	222902	19450	33972	30595	15438	20760	8805	28301	22400	9815	29952	24138	35594	38765	16796	20325	12305	61149	26221	27887	95106	1976
Sco	30138	2184	4048	5514	2141	3604	1832	4493	5844	1623	5890	4320	5512	4597	3167	2748	2016	9461	2984	3098	13313	290
Wal	10074	749	1713	1192	748	892	457	1243	1422	644	2181	1584	1837	2103	860	1112	458	3404	1214	1250	4391	66
NI	6956	335	570	551	796	428	276	707	581	752	861	317	1143	1151	836	794	84	1640	700	474	2409	22
NW	27721	2367	2566	4483	2325	2295	1137	3029	2590	960	3793	2530	5218	4330	3002	2557	1316	7711	3594	2966	11241	218
East	18517	1403	4095	4526	940	3718	1159	3949	2602	913	3358	2718	3790	4341	3839	2022	1420	6088	3114	2736	10033	340
WM	21402	1129	2083	3322	1095	1171	650	2279	869	773	2112	1052	3443	3319	2340	1799	1547	6336	2710	2939	7821	147
Lon	92829	9639	16700	8081	4797	7439	2526	8577	3276	1997	5850	3989	7880	14881	3914	5717	2918	14405	6651	7371	28743	628
SW	14721	894	2295	2891	813	1676	748	2280	3211	839	4581	3792	2828	4081	1083	1534	1255	5005	2145	2356	8694	190
EM	16619	767	1975	1764	1055	1155	626	1859	1781	1090	2094	1468	2912	3541	1445	1990	648	6507	2337	2426	6748	101
SE	34149	4299	6254	8722	2147	4047	1782	5814	3488	1941	6114	6218	5878	8504	5107	3536	2747	8781	4109	5707	19723	462
NE	10315	542	2069	1954	582	1004	445	1378	871	552	1681	1996	2095	1872	2214	1200	695	3735	1358	1848	5987	80
YH	22213	983	1970	3222	1502	1460	583	2501	1413	1143	3403	3123	3966	3465	1293	1759	861	7036	2773	2888	10480	139

Abbreviations used for ESI subject categories

CLIN	**Clinical Medicine**	**GEOS**	**Geosciences**
IMMU	**Immunology**	**CHEM**	**Chemistry**
NEUR	**Neuroscience & Behavior**	**PHYS**	**Physics**
PSYC	**Psychiatry/Psychology**	**SPAC**	**Space Science**
PHAR	**Pharmacology & Toxicology**	**COMP**	**Computer Science**
MOLE	**Molecular Biology & Genetics**	**MATH**	**Mathematics**
MICR	**Microbiology**	**ENGI**	**Engineering**
BIOL	**Biology & Biochemistry**	**MATE**	**Materials Science**
PLAN	**Plant & Animal Science**	**ECON**	**Economics & Business**
AGRI	**Agricultural Sciences**	**SOCI**	**Social Sciences, general**
ENVI	**Environment/Ecology**	**MULT**	**Multidisciplinary**

Abbreviations used for regions:

UK	**United Kingdom**	WM	**West Midlands**
Eng	**England**	Lon	**London**
Sco	**Scotland**	SW	**South West**
Wal	**Wales**	EM	**East Midlands**
NI	**Northern Ireland**	SE	**South East**
NW	**North West**	NE	**North East**
East	**East**	YH	**Yorkshire and Humberside**

Table 2. Research specialisation as measured by the Gini coefficient across ITL 1 regions and over three time periods

ITL1 Region	2001-2005	2011-2015	2021-2025
North East (England) – NE	0.256	0.229	0.204
North West (England) – NW	0.231	0.204	0.192
Yorkshire and The Humber – YH	0.222	0.194	0.188
East Midlands (England) – EM	0.250	0.222	0.208
West Midlands (England) – WM	0.242	0.220	0.214
East (England) – East	0.262	0.208	0.188
London – Lon	0.268	0.242	0.243
South East (England) – SE	0.178	0.172	0.171
South West (England) – SW	0.235	0.230	0.233
Wales – Wales	0.263	0.247	0.225
Scotland – Sco	0.222	0.196	0.169
Northern Ireland – NI	0.326	0.297	0.289

Table 3. Relationship between institutional and regional research specialisation across UK ITL2 regions (2021–2025)

ITL2 Region Name	ITL2 Code	Average institutional specialisation	Overall regional specialisation
Bedfordshire and Hertfordshire	H2	0.645	0.568
Berkshire, Buckinghamshire, and Oxfordshire	J1	0.577	0.260
Cambridgeshire and Peterborough	H4	0.290	0.290
Cheshire	D6	0.564	0.564
Cornwall and Isles of Scilly	K3	0.904	0.904
Cumbria	D1	0.741	0.741
Derbyshire and Nottinghamshire	F1	0.449	0.256
Devon	K4	0.539	0.383
East Central Scotland	M1	0.569	0.216
East Yorkshire and Northern Lincolnshire	E1	0.431	0.431
Eastern Scotland	M0	0.601	0.368
Essex	H3	0.563	0.502
Gloucestershire and Wiltshire	K7	0.744	0.681
Greater Manchester	D3	0.571	0.269
Hampshire and Isle of Wight	J3	0.572	0.317
Herefordshire, Worcestershire, and Warwickshire	G1	0.608	0.645
Highlands and Islands	M2	0.776	0.776
Inner London - East	I4	0.587	0.310
Inner London - West	I3	0.746	0.284
Kent	J4	0.529	0.448
Lancashire	D4	0.509	0.354
Leicestershire, Rutland, and Northamptonshire	F2	0.540	0.308
Lincolnshire	F3	0.673	0.497
Merseyside	D7	0.592	0.327
Mid and South West Wales	L4	0.671	0.341

Table 3. Relationship between institutional and regional research specialisation across UK ITL2 regions (2021–2025)			
Norfolk	H5	0.593	0.446
North Eastern Scotland	M5	0.724	0.457
North Somerset, Somerset, and Dorset	K6	0.675	0.576
North Wales	L3	0.719	0.631
North Yorkshire	E2	0.519	0.367
Northern Ireland	N0	0.448	0.289
Northumberland, Durham, and Tyne & Wear	C4	0.457	0.207
Outer London - East and North East	I5	0.552	0.513
Outer London - South	I6	0.482	0.482
Outer London - West and North West	I7	0.604	0.442
Shropshire and Staffordshire	G2	0.670	0.512
South East Wales	L5	0.603	0.260
South Yorkshire	E3	0.414	0.281
Suffolk	H6	0.624	0.624
Surrey, East and West Sussex	J2	0.577	0.303
Tees Valley	C3	0.491	0.491
West Central Scotland	M3	0.540	0.266
West Midlands	G3	0.544	0.227
West of England	K5	0.487	0.245
West Yorkshire	E4	0.583	0.296

Appendix 3: Data for Section 4

Aston University

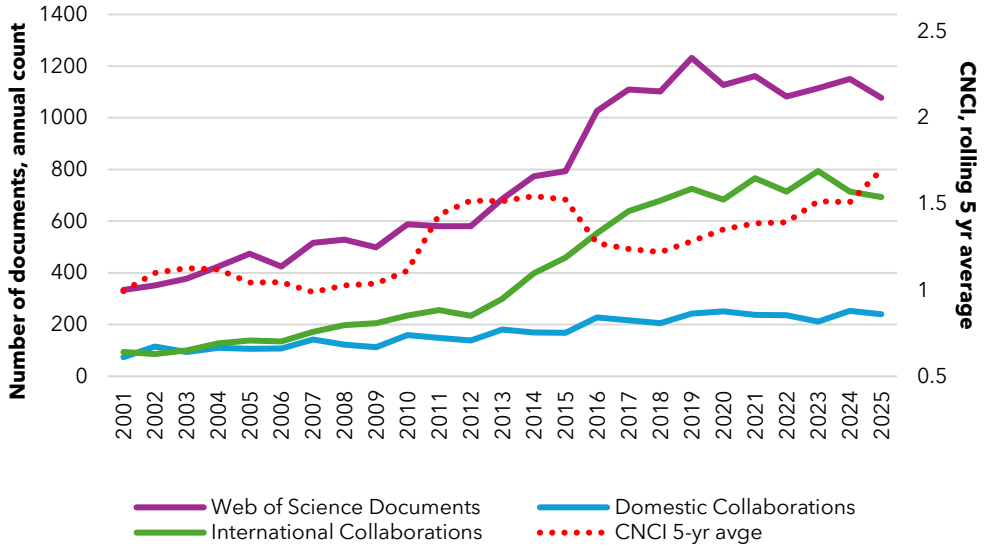


Figure 1a – Research output trends across collaboration types and the CNCI trend of Aston University (2001-2025)

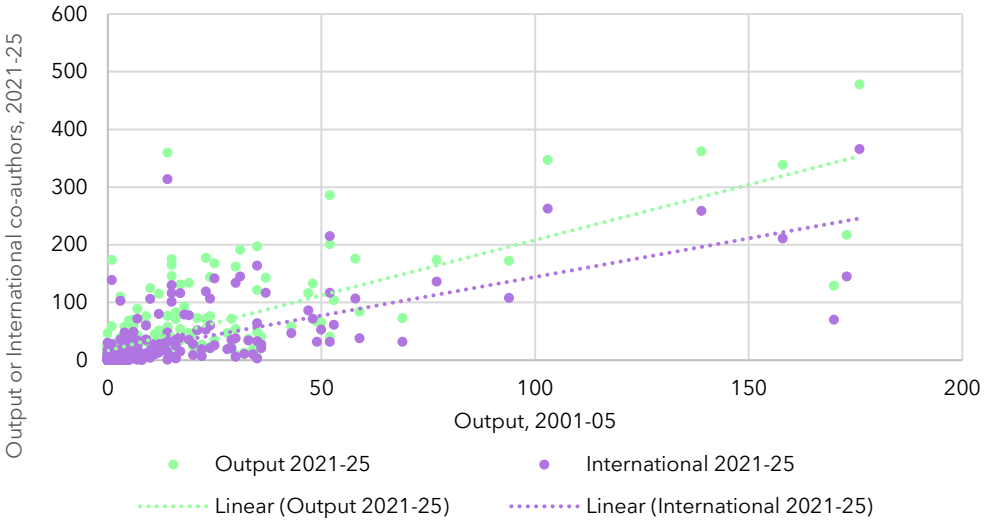


Figure 1b – Comparison of Journal Subject Category output of Aston University in two periods (2021-2025 and 2001-2005)

Total output in Figure 1a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). Citation impact is variable but rising. The diagonal in Figure 1b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier.

The number of outputs that are internationally collaborative is generally highest in those areas in which the institution was already most active. In subject categories with fewer outputs, the contribution from collaboration is more variable but a very large rise from a low base in Energy & Fuels is notable. Growth has been relatively higher in subject categories of medium size, whereas some smaller categories have clearly shrunk (they are above the line so were larger in the past). The intermediate sized categories have more frequent international collaboration.

Aston's most frequent collaborators are domestic with Birmingham, Warwick and Nottingham (regional) in the top ten with UCL, King's London, Cambridge and Oxford. International collaborators are widespread with some of the more frequent in Asia-Pacific, as might be expected for a university with a strong technology base.

University of Birmingham

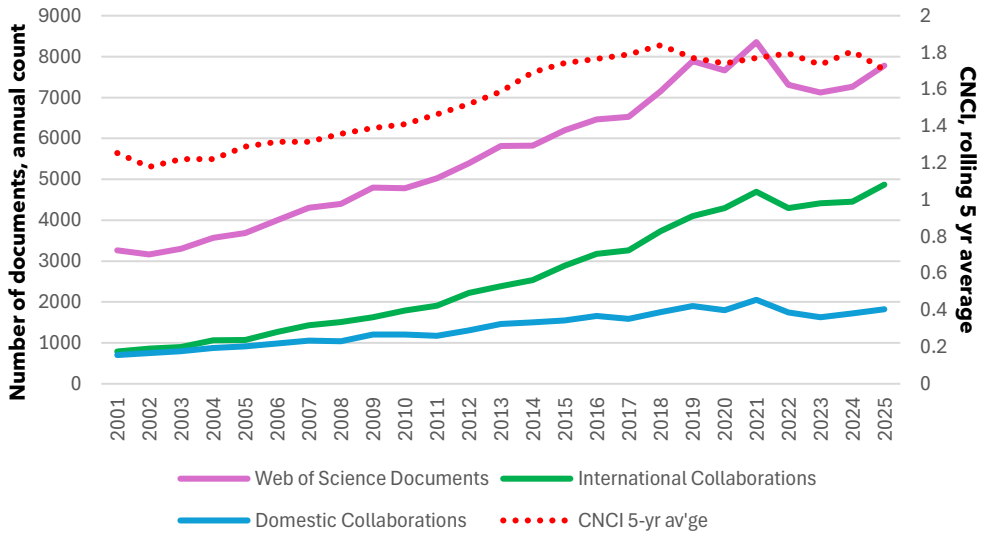


Figure 2a – Research output trends across collaboration types and the CNCI trend of University of Birmingham (2001-2025)

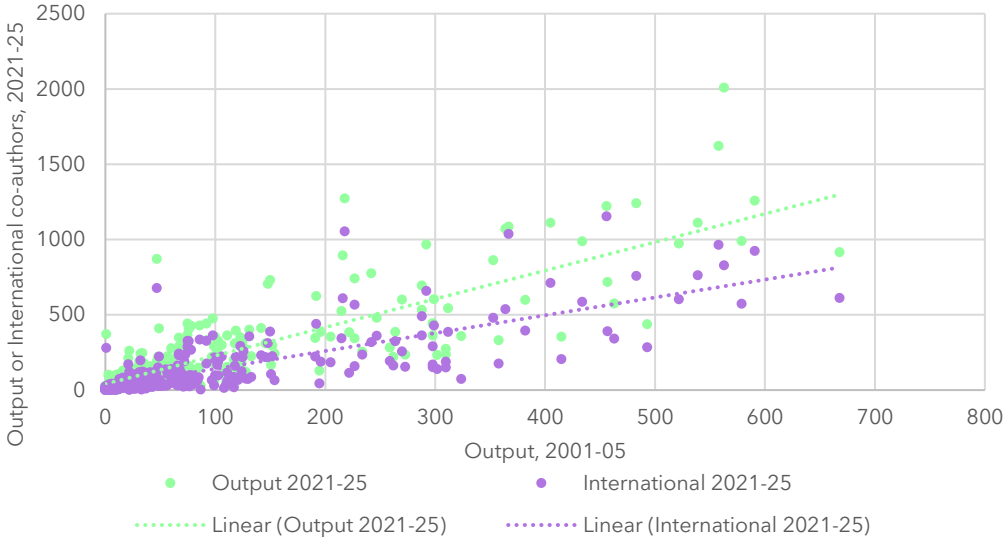


Figure 2b – Comparison of Journal Subject Category output of University of Birmingham in two periods (2021-2025 and 2001-2005)

Total output in Figure 2a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose in the middle period but has since plateaued with surprising annual variation given the institution's size.

The diagonal in Figure 2b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of small and intermediate sized categories have diminished slightly. The number of outputs that is are internationally collaborative is generally highest in those areas in which the institution was already most active. In subject categories with fewer

outputs, the contribution from collaboration is more variable. However, Surgery has grown significantly with only moderate international collaboration, as has Oncology. Environmental Sciences has also expanded substantially and has a high level of international collaboration.

The most frequent collaborators are other research-intensive UK universities. The most frequent international collaborators include many EU universities (especially in France, Germany and Italy) and the US and Canada. Collaboration with Asia occurs but has been relatively less common, with some rise in the last decade.

Brunel University

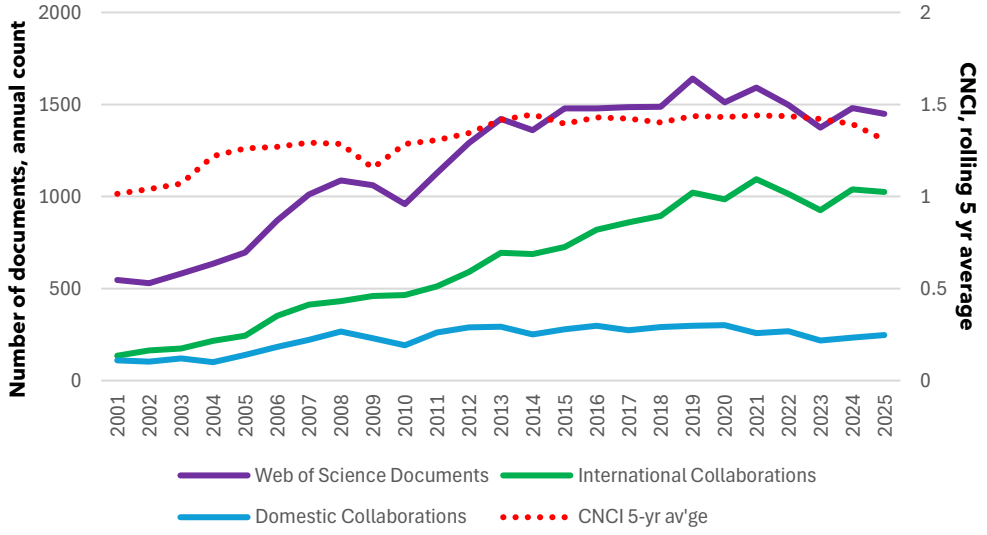


Figure 3a – Research output trends across collaboration types and the CNCI trend of Brunel University (2001-2025)

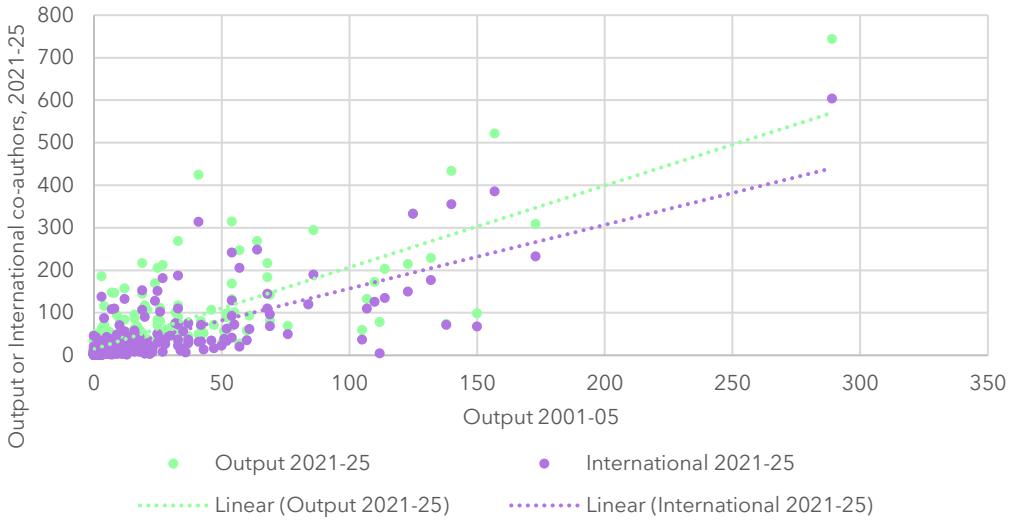


Figure 3b – Comparison of Journal Subject Category output of Brunel University in two periods (2021-2025 and 2001-2005)

Total output in Figure 3a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose from around world average and is now sustained at just under 1.5 times that benchmark.

The diagonal in Figure 3b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A

small number of small categories have diminished slightly. There is a strong relationship between growth and international collaboration at subject level. Growth driven by collaboration in established areas is most marked in Electrical Engineering and Materials Science while it has enabled Fuel & Energy to grow from a very small base. Business Studies and Management have also expanded with collaboration.

Collaboration is strongly international, although the most frequent collaborator is Imperial College. The list is extensive with many institutions in Italy and the US. International collaboration was strong and diverse until 2018 but plateaued more recently, both for many of the more frequent collaborators as well as overall, in line with the institutional profile.

Imperial College London

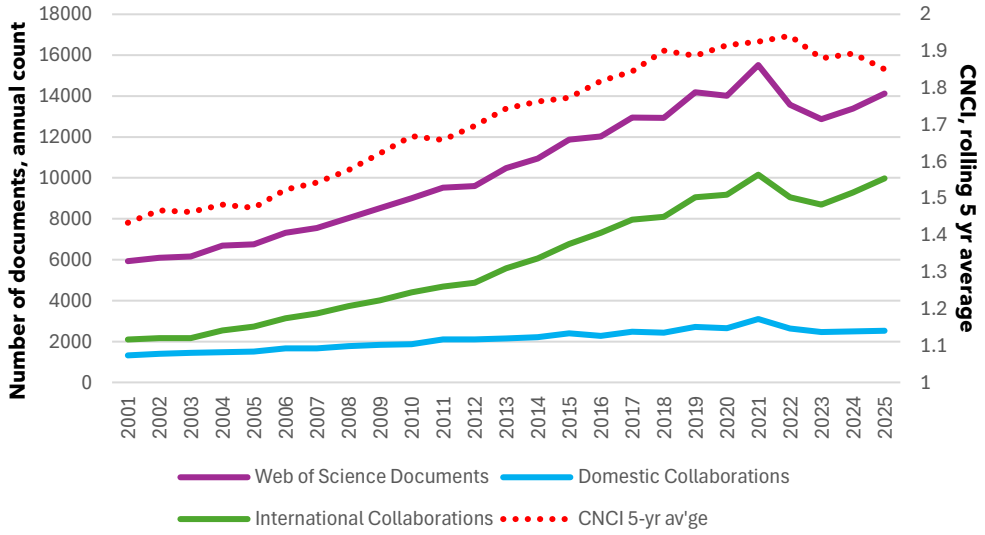


Figure 4a – Research output trends across collaboration types and the CNCI trend of Imperial College London (2001-2025)

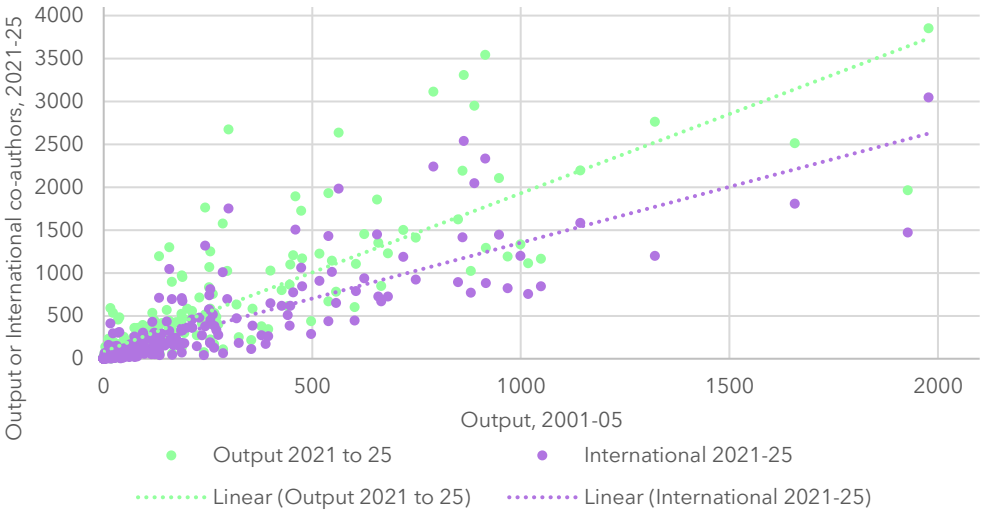


Figure 4b – Comparison of Journal Subject Category output of Imperial College London in two periods (2021-2025 and 2001-2005)

Total output in Figure 4a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose in the middle period but has since plateaued (close to twice world average).

The diagonal in Figure 4b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of small and intermediate sized categories have diminished slightly. Biochemistry and Molecular Biology is an area where IC has a significant track record, but it has grown very little and has a relatively low level of international collaboration. Interpretation of this outcome would need examination of related fields into which research may have moved. Public & Environmental Heath has grown five-fold and has a high level of international collaboration, reflecting Imperial's relationship with its new campus at St Mary's.

Frequent collaborators are research-intensive UK universities and leading universities in France (Paris Saclay, Sorbonne), Italy (La Sapienza, Padua) and the US (Harvard, Johns Hopkins) with a global network of similar institutions. Growth in international collaborations is driven. Collaboration with leading institutions across Asia has strengthened considerably over the past decade, with partnerships in key emerging research hubs growing rapidly and now contributing at levels comparable to many of Imperial´s more established international collaborations.

Coventry University

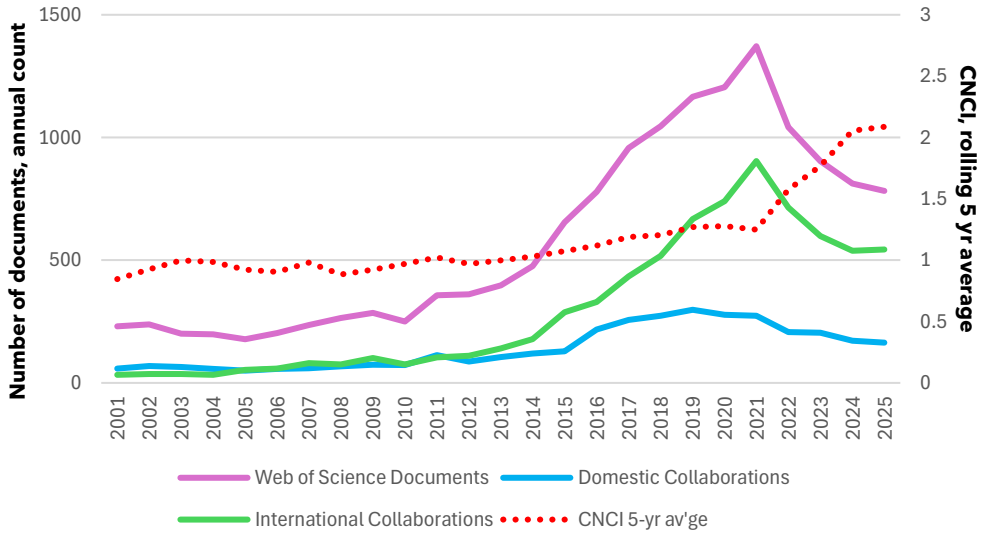


Figure 5a – Research output trends across collaboration types and the CNCI trend of Coventry University (2001-2025)

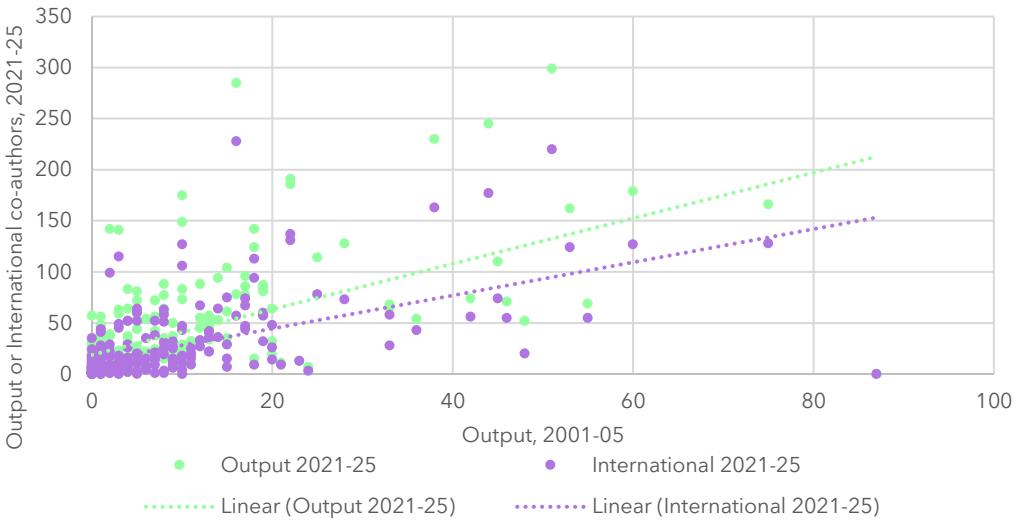


Figure 5b – Comparison of Journal Subject Category output of Coventry University in two periods (2021-2025 and 2001-2005)

Total output in Figure 5a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose above world average in the middle period but a peak (possibly linked to post-CoVid activity) obscures the recent trend.

The diagonal in Figure 5b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A small number of small categories have diminished slightly. There is a strong relationship between growth and international collaboration at subject level. Electrical Engineering and Environmental Sciences have both benefitted from this, while Nutrition has grown strongly from almost nothing largely on the back of collaboration.

Frequent collaborators are UK universities, particularly those in the West and East Midlands including Warwick, Birmingham, Leicester, Loughborough and Aston. International links with Australasia (Deakin, Monash) and in the Middle East have notably grown in the last decade.

De Montfort University

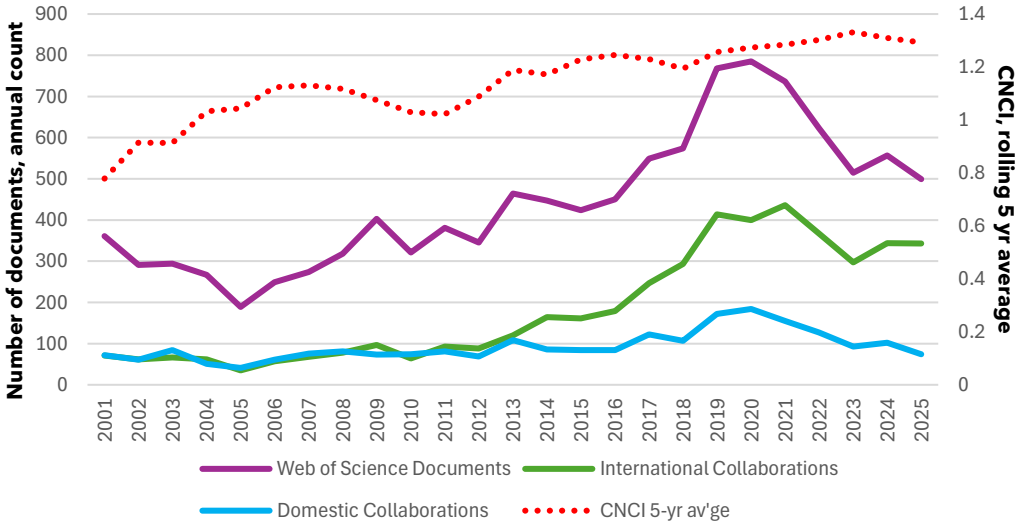


Figure 6a – Research output trends across collaboration types and the CNCI trend of De Montfort University (2001-2025)

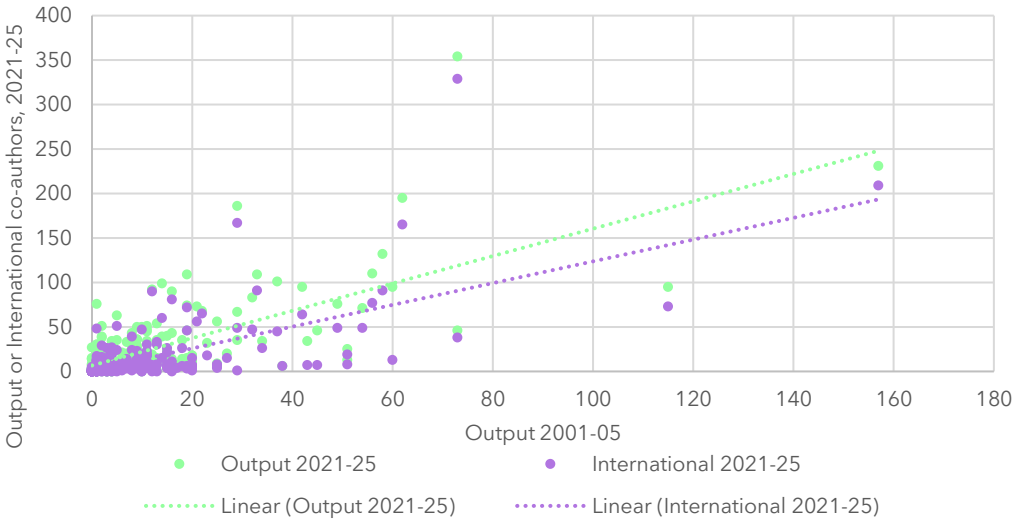


Figure 6b – Comparison of Journal Subject Category output of De Montfort University in two periods (2021-2025 and 2001-2005)

Total output in Figure 6a rises over the period at the same time as growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose in the middle period but annual fluctuations are quite marked.

The diagonal in Figure 6b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of small and one intermediate sized category diminished slightly over the period. Research in AI and Software Engineering has expanded very substantially and is primarily driven by international collaboration. Electrical Engineering was already well established and has grown but is less dependent on collaboration.

Frequent collaborators are regional universities including Leicester, Loughborough, Nottingham and Warwick. Most collaboration has been UK based in the past but collaboration with China (Nanjing, Xiangtan, Zhejiang) expanded markedly after 2018. There has been a spread of other but relatively short-lived international collaborations.

Leeds Beckett University

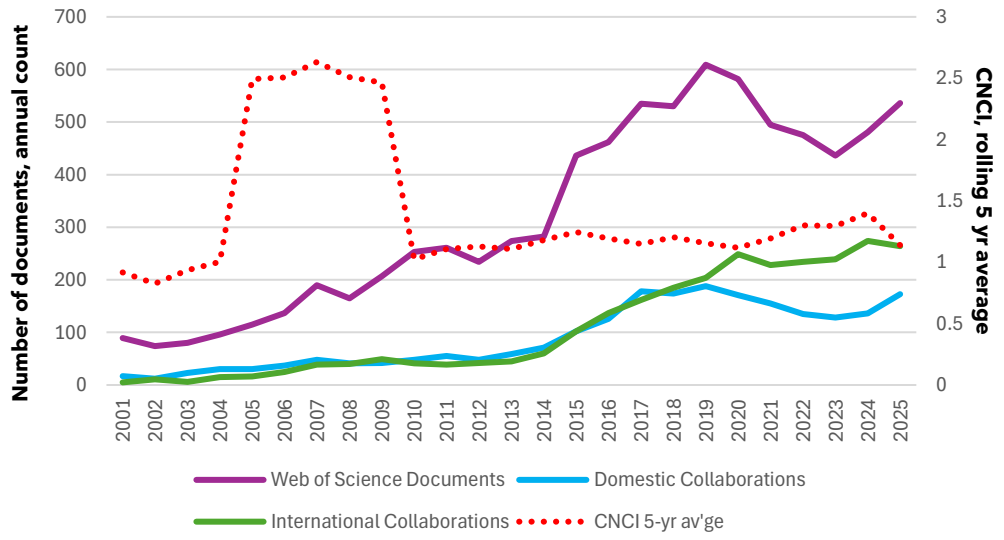


Figure 7a – Research output trends across collaboration types and the CNCI trend of Leeds Beckett University (2001-2025)

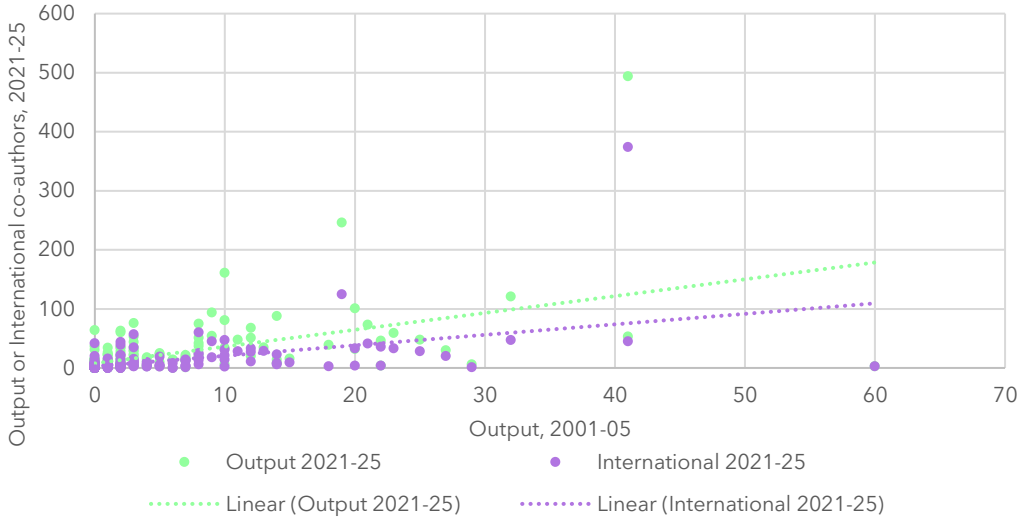


Figure 7b – Comparison of Journal Subject Category output of Leeds Beckett University in two periods (2021-2025 and 2001-2005)

Total output in Figure 7a rises over the period alongside the growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose close to world average in the recent period (the peak in 2007 is likely due to a small number of exceptional papers in typically low-cited arts and humanities areas).

The diagonal in Figure 7b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. There is a marked relationship between growth and international collaboration at subject level, but this institution has focussed on a relatively small number of key subjects, while output classified as Engineering has essentially disappeared.

Sports Science and Hospitality & Sport Tourism grew ten-fold and more than 75% of their output is now internationally collaborative. There has also been growth in Public Health and Education and though these are collaborative they are less driven by that.

While frequent collaborators have generally been regional in the past (Leeds, Hull, Sheffield, Sheffield Hallam, Newcastle), there has been significant collaboration with the University of Cape Town and the Australian Catholic University. This has been almost entirely in Sports Science.

University of the West of England Bristol

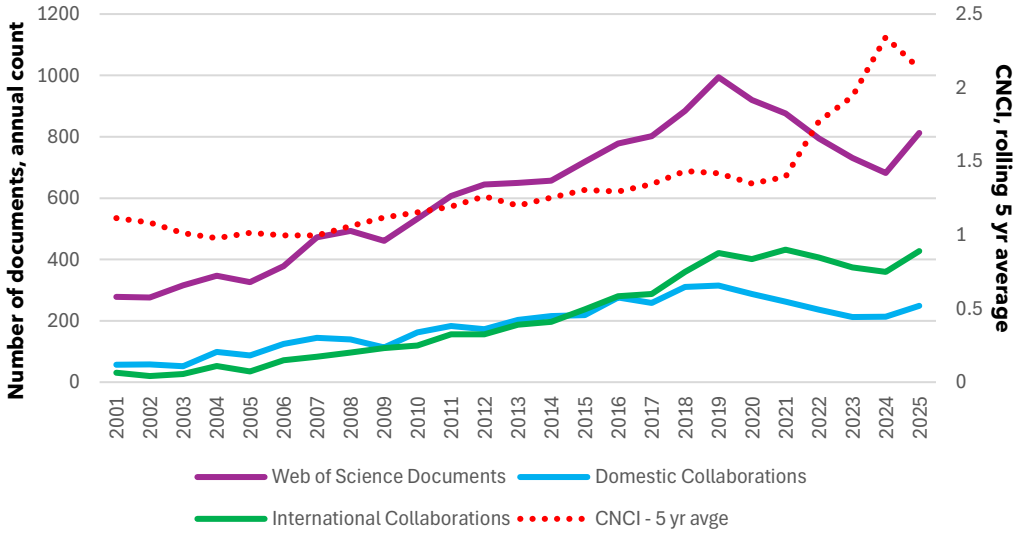


Figure 8a – Research output trends across collaboration types and the CNCI trend of University of the West of England Bristol (2001-2025)

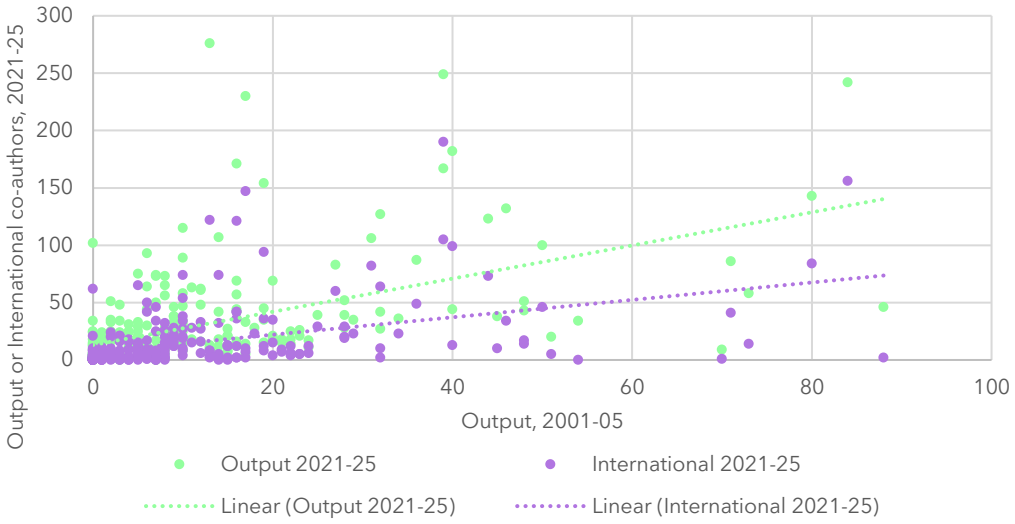


Figure 8b – Comparison of Journal Subject Category output of University of the West of England Bristol in two periods (2021-2025 and 2001-2005)

Total output in Figure 8a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant) although there is a marked peak in 2019 and a decline to 2024, perhaps linked to COVID. Citation impact has been consistently above world average and is rising.

The diagonal in Figure 8b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. The number of outputs that is are internationally collaborative is generally highest in those areas in which the institution was already most active. In subject categories with fewer outputs, the contribution from collaboration is more variable.

Substantial growth in Robotics, Automation & Control Systems and Materials Science is strongly driven by collaboration. Rheumatology has also been boosted which may suggest the possibility of a human-factors link between these topics.

Frequent collaborators are mostly UK universities but there are sustained links with Toronto, Auckland and Melbourne universities.

Bangor University

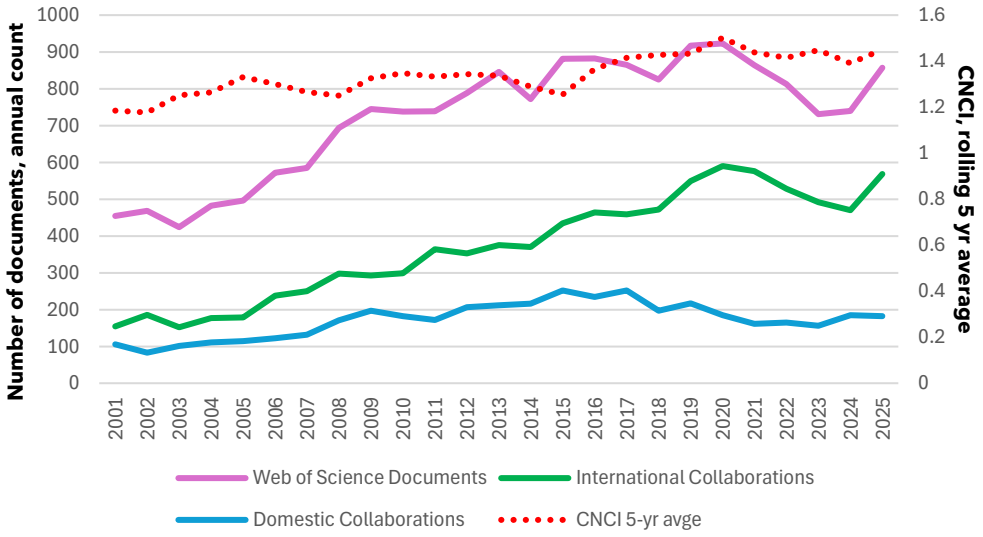


Figure 9a – Research output trends across collaboration types and the CNCI trend of Bangor University (2001-2025)

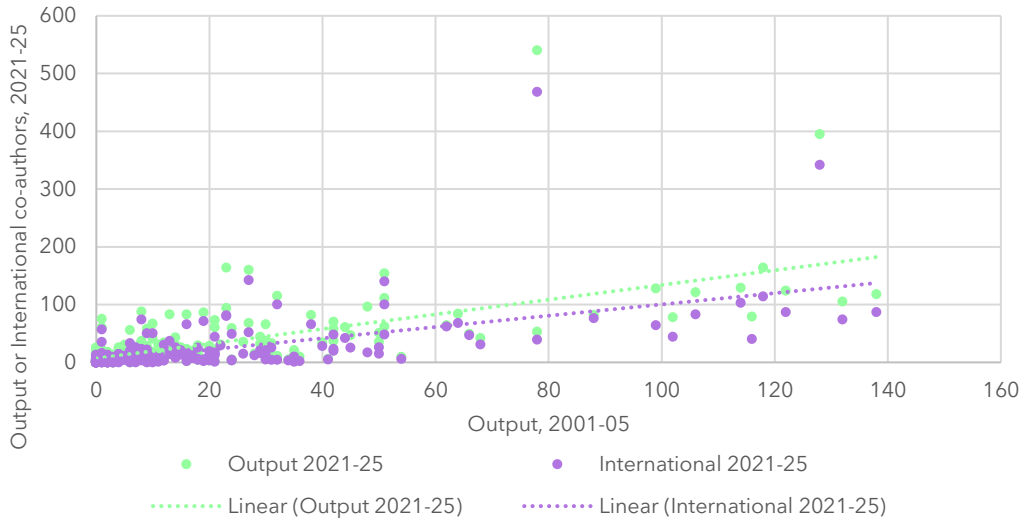


Figure 9b – Comparison of Journal Subject Category output of Bangor University in two periods (2021-2025 and 2001-2005)

Total output in Figure 9a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI has not changed markedly over the middle period but is sustained above world average.

The diagonal in Figure 9b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of small and intermediate sized categories diminished slightly over the period.

Research in AI and Software Engineering has expanded very substantially and is primarily driven by international collaboration. Electrical Engineering was already well established and has grown but is less dependent on collaboration. Growth in Ecology and in Environmental Sciences has been exceptional and is strongly linked to international collaboration. These are areas in which Bangor has had a track record for over 50 years and clearly builds on strength and reputation. For example, Marine & Freshwater Biology are intermediate categories that have grown whereas Oceanography research was established, has grown less and is less collaborative.

Collaboration is most extensive with other research-intensive UK universities, led by Cardiff but also consistent with Liverpool (Marine) and Oxford (Ecology). International collaboration is a global network, although Asia-Pacific links are uncommon.

Cardiff University

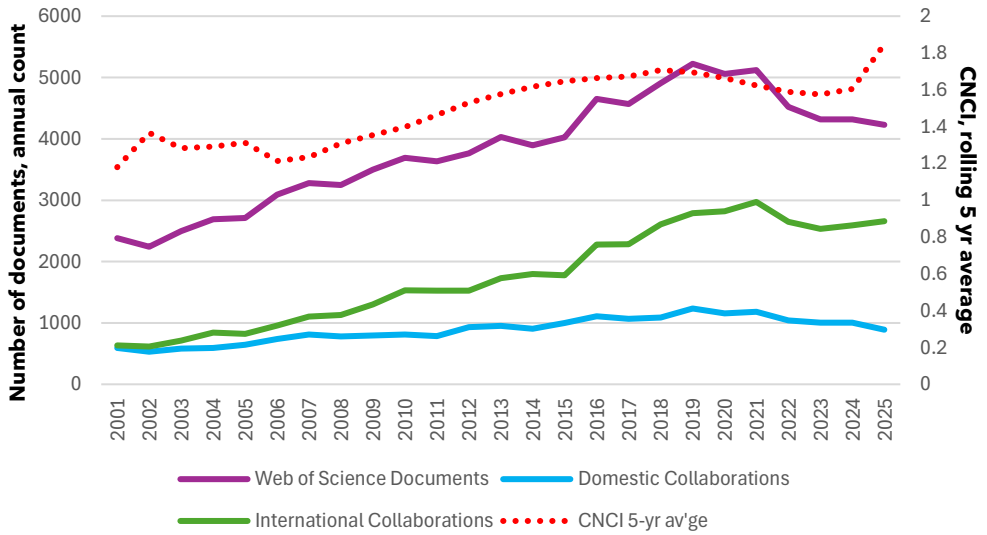


Figure 10a – Research output trends across collaboration types and the CNCI trend of Cardiff University (2001-2025)

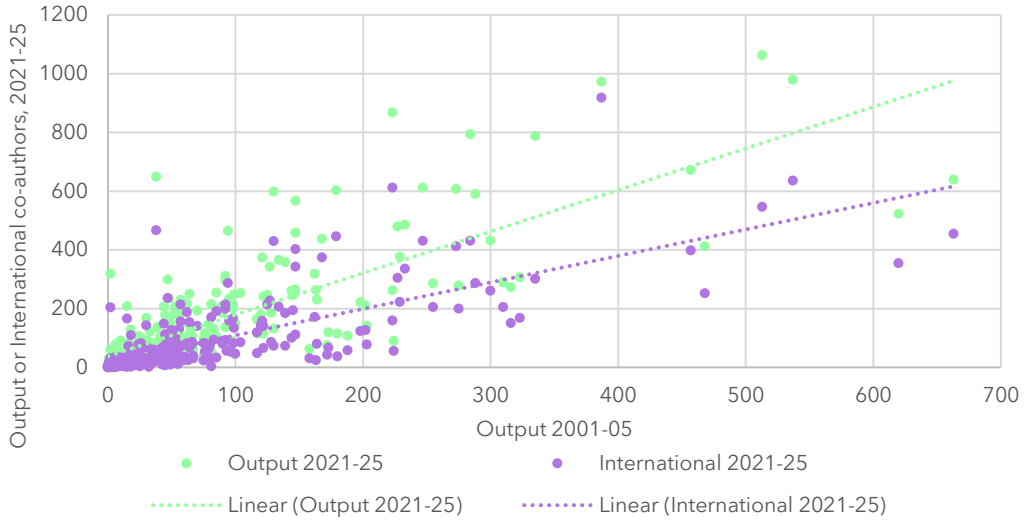


Figure 10b – Comparison of Journal Subject Category output of Cardiff University in two periods (2021-2025 and 2001-2005)

Total output in Figure 10a rises over the period lifted by growing international collaboration (the gap between total and rising collaboration is constant). CNCI rose steadily and has now plateaued above 1.5 times world average.

The diagonal in Figure 10b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of categories of various sizes diminished slightly over the period: Organic Chemistry fell to one-third of its earlier output. Growth in medically-related, linked areas (Psychiatry, Neurosciences, Clinical Neurology) was substantial and linked to international collaboration. Astronomy grew on the back of its global network of collaboration. Electrical Engineering and Computer Science (four-fold) and Energy & Fuels (ten-fold) also expanded through a high level of international collaboration.

Collaboration is most frequent with other research-intensive UK universities including UCL, Kings London, Oxford, Cambridge and Bristol. Internationally, north America (Harvard, Toronto, Caltech) and Australia (Melbourne, Monash) are frequent and there is also a wide-ranging EU network. The University of Hong Kong and Seoul University are the most frequent links in Asia.

Abertay University

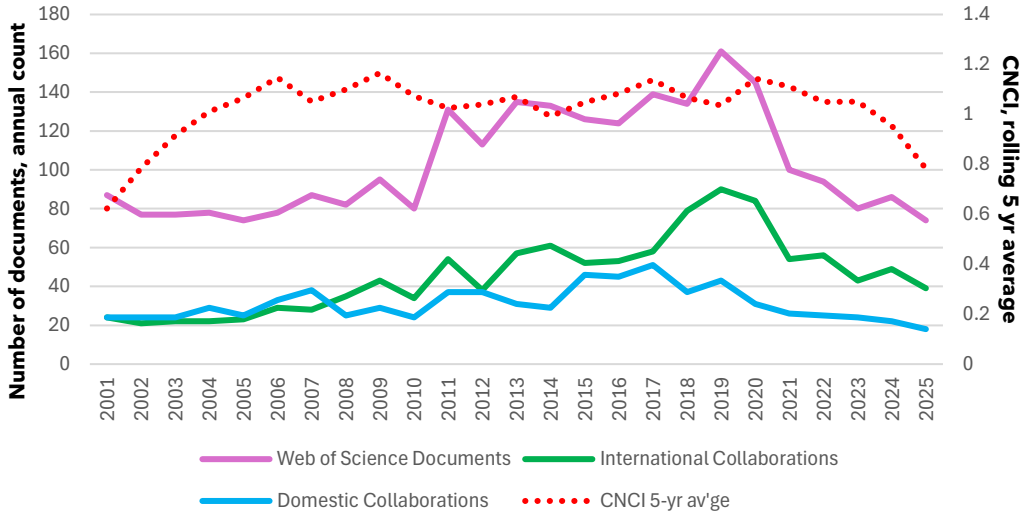


Figure 11a – Research output trends across collaboration types and the CNCI trend of Abertay University (2001-2025)

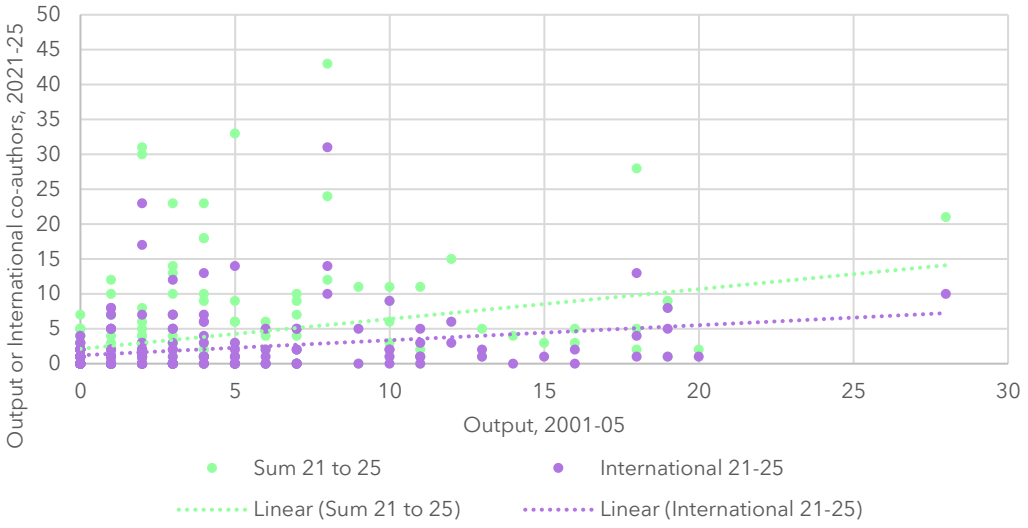


Figure 11b – Comparison of Journal Subject Category output of Abertay University in two periods (2021-2025 and 2001-2005)

Total output in Figure 11a rose markedly in the middle period but then fell back after 2019. It had been lifted by growing international collaboration and this too fell back sharply. CNCI, which had been slightly above world average, also fell, probably bas a consequence.

The diagonal in Figure 11b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of relatively prolific subjects diminished over the period (notably health and environmental related) while subject categories around computer science were the principal growth areas.

Other universities in Scotland were the most frequent collaborators. The international links are widely dispersed but Australian universities are among the more frequent.

University of Aberdeen

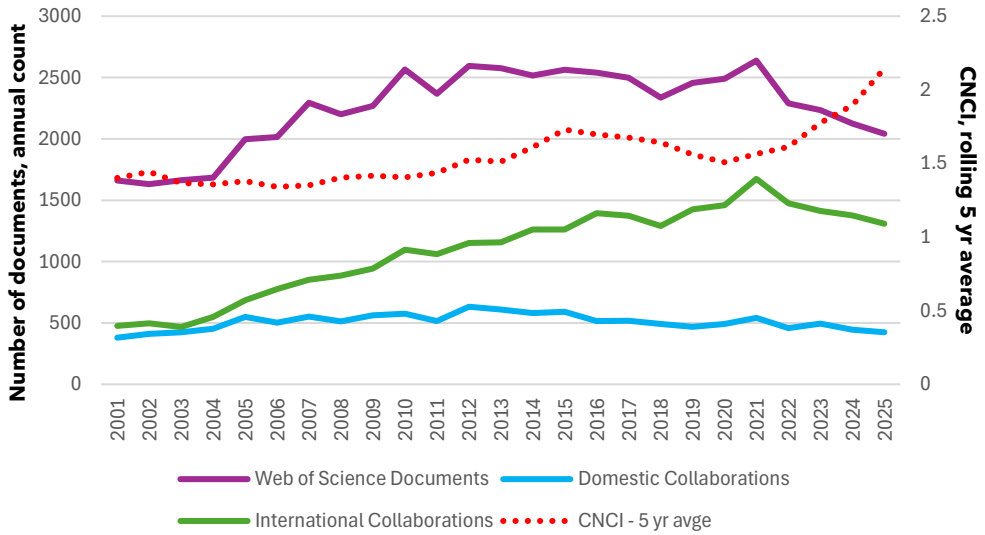


Figure 12a – Research output trends across collaboration types and the CNCI trend of University of Aberdeen (2001-2025)

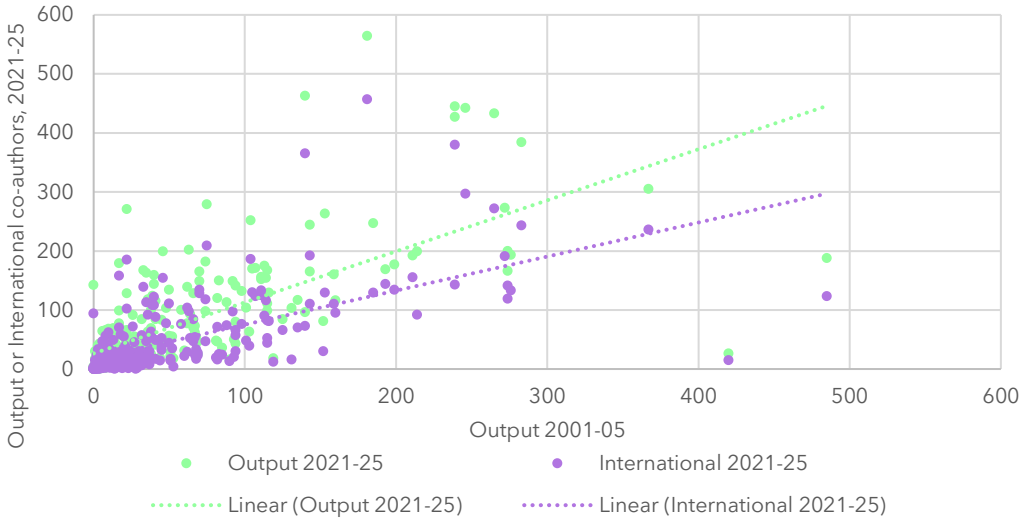


Figure 12b – Comparison of Journal Subject Category output of University of Aberdeen in two periods (2021-2025 and 2001-2005)

Total output in Figure 12a rises over slightly in the middle period, but domestic collaboration falls and total output is sustained, until 2021, by growing international collaboration (the gap between total and rising collaboration gets smaller). CNCI rose in the middle period, but annual fluctuations later are marked.

The diagonal in Figure 12b marks equality between 2001-05 and 2021-25; points above the line are subject categories where output is greater in 2025 than earlier. A number of categories diminished over the period, indicating likely retrenchment. Crystallography almost disappeared; Endocrinology and some other medically-related categories more than halved; Biochemistry fell back slightly but was sustained by relatively strong international collaboration. However, Environmental Sciences and Geosciences (and related topics) grew substantially on the back of high levels of collaboration.

The most frequent collaborators are other universities in Scotland, particularly Edinburgh, Glasgow and Dundee, and other research-intensive UK universities. International links are very widespread and are notably led by network organizations such as the CNRS (France), the Helmholtz Association (Germany), Consejo Superior de Investigaciones Cientificas (Spain), Chinese Academy of Sciences and the University of California System as well as including individual institutions.

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